INDEXED

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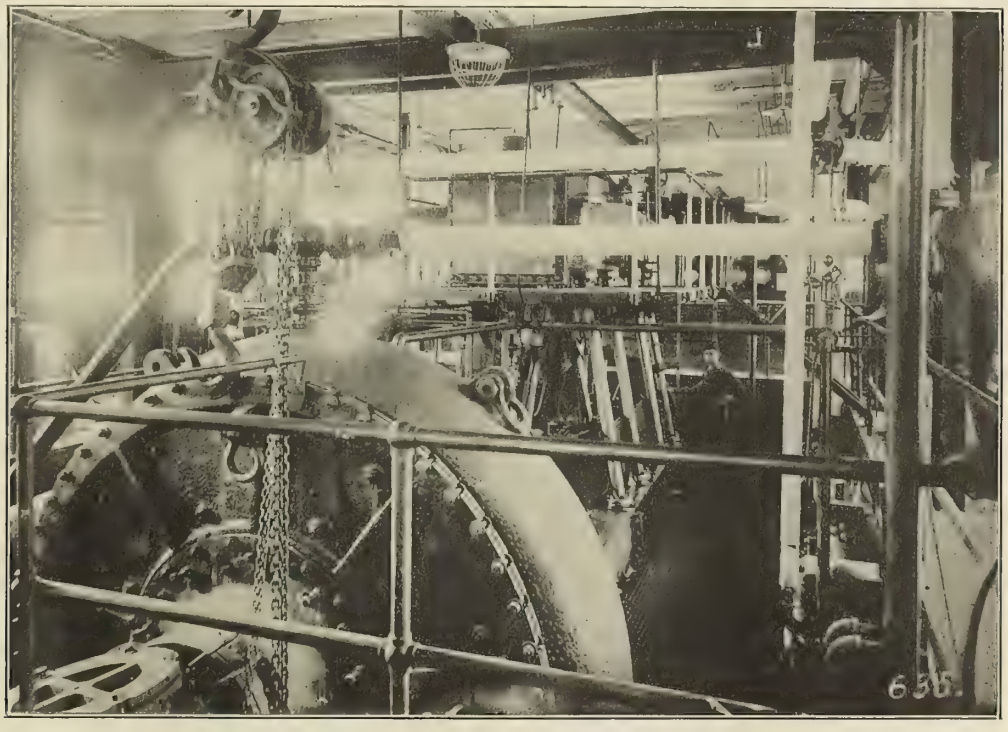
Hydraulic Suction Dredge for Canal Work

The Morris Machine Works, Baldwinsville, N. Y., during the past year has built for the American Pipe & Construction Company a 20-inch hydraulic suction dredge for use at Amsterdam, N. Y., on one of the New York State Barge Canal contracts. The dredge has a wood hull of the following dimensions: Length, 137 feet 8 inches; breadth, 40 feet, and depth, 10 feet 2 inches.

The main dredging pump is made throughout of manganese steel, with an average thickness of 3¼ inches. It is unlined around the periphery. The main pump shell is fitted with removable side disks, which are lined with manganese steel circular plates on their inner faces. The runner is also of manganese steel, with five vanes, and is 90 inches in diameter, mounted on a steel shaft 10 inches in diameter. The pump is operated at speeds up to 225 revolutions per minute, and easily maintains a discharge pressure on the pipe line of 60 pounds per square inch. Both the suction and discharge are 20 inches diameter.



MAIN DREDGING PUMP DRIVEN BY TRIPLE-EXPANSION ENGINE

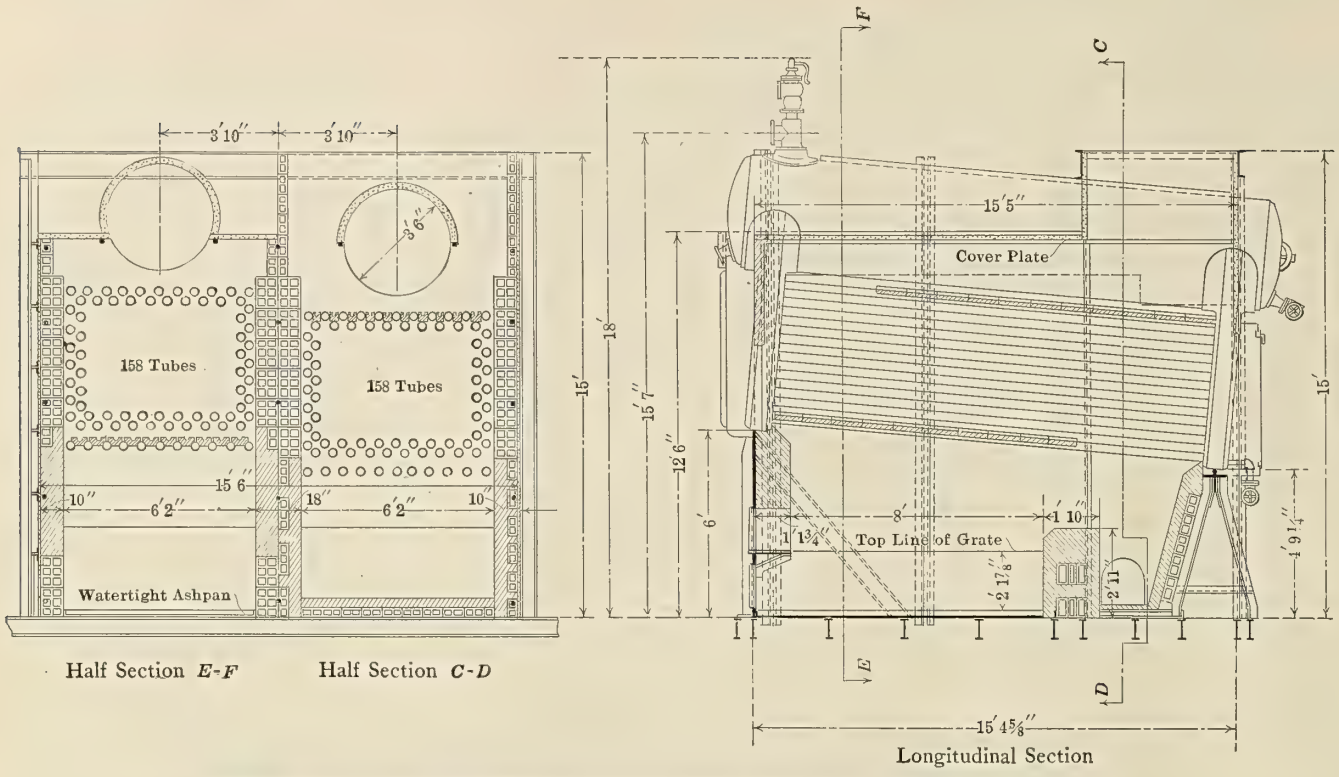
The triple expansion engine, which is directly connected to the pump, has cylinders 17 inches, 27½ inches and 42 inches in diameter, with a common stroke of 20 inches. It is capable of delivering 1,000 horsepower. The engine is of open-frame type, giving full view of all the working parts, and all parts throughout are of exceptionally heavy proportions to operate without ceasing at high speed, and with a working steam pressure of 200 pounds per square inch. A water-cooled multi-collar marine thrust bearing is provided to take the unbalanced end thrust of the dredging pump.

The pump and engine are mounted together on a cast iron sub-base, which in turn rests on a structural steel base built up from the bottom of the dredge hull.

The cutter ladder, which is 50 feet long, is mounted within a ladder well in the bow of the dredge. The ladder is made throughout of structural steel of very heavy proportions. The ladder driving shaft is made of steel 8½ inches in diameter, supported in babbitt-lined bearings with removable shells. A multi-collar thrust bearing of marine type holds the ladder shafting in perfect position.

The normal speed of the cutter shaft is 12 revolutions per minute. The cutter shaft is driven through cast steel cut gearing from a 12-inch by 12-inch horizontal double engine running at about 225 revolutions per minute.

The boiler equipment consists of four Heine watertube boilers, each of 225 horsepower, carrying steam at 200 pounds pressure. The boilers are arranged in two batteries facing together and have two smokestacks. Forced draft is used.



DETAILS OF ONE OF THE 225-HORSEPOWER HEINE WATERTUBE BOILERS INSTALLED ON THE CANAL DREDGE

The winding machinery consists of an 8¼-inch by 12-inch double cylinder compound-geared Flory engine, with cast steel framing, drums and gears, and of heavy construction throughout. The swinging drums are 24 inches diameter, the ladder hoist and spud hoist are 20 inches in diameter.

The machinery equipment includes a surface condenser having 2,000 square feet of cooling surface, with two 8-inch discharge centrifugal circulating pumps so arranged that they can deliver through the condenser in opposite directions, only one pump being in service at a time. The air pump is of the vertical twin beam type 7½ inches by 16½ inches by 10 inches. The auxiliary equipment also includes a 15-kilowatt direct connected generator.

HYDRAULIC SUCTION DREDGE AT WORK ON THE NEW YORK STATE BARGE CANAL

Seagoing Suction Dredge Col. P. S. Michie.—The Seattle Construction and Dry Dock Company, Seattle, Wash., has under construction for the United States Engineer Office of the War Department a twin screw seagoing suction dredge of the central well type, which is to be put into commission in May of this year. The dredge, which is named the *Col. P. S. Michie*, is 230 feet long by 43 feet beam. This company, which has one of the best equipped shipyards on the Pacific Coast for the manufacture of various types of dredging machinery and equipment, has built a large variety of suction, bucket, dipper, clamshell and orange-peel dredges, including the largest clamshell dredging equipment employed on the Panama Canal, besides many other important installations.

An 8-Cubic Yard Dipper Dredge

One of the most modern and best-equipped dipper dredges on the Great Lakes will be put in operation this spring by the Fitz Simons & Connell Dredge & Dock Company, of Chicago. The hull, which is steel throughout of exceptionally rigid construction, was designed and built by the Manitowoc Ship Building & Dry Dock Company, Manitowoc, Wis., and the machinery, including the A-frame, boom, swing circle and dipper, all furnished by the Bucyrus Company, of South Milwaukee, Wis., was installed at the same place.

The general dimensions of the dredge are: Length, 110 feet; beam, 40 feet; depth, 11 feet 6 inches forward and 10 feet 6 inches aft. The bottom framing consists of floors 42 inches high spaced 9 feet, extending from side to side of the hull. Between these floors there is light channel framing. Two 42-inch fore and aft plate engine girders run the full length of the dredge, and are cut and clipped to each high floor. In place of the usual trusses below the main deck this dredge has two watertight bulkheads extending from stem to stern. Necessary openings through the bulkheads are equipped with watertight doors.

In line with the spud casings, which are set back 10 feet from the bow, there is an athwartship watertight bulkhead which not only takes the racking strains at the spuds, but forms a watertight compartment at the forward end. This compartment serves the purpose of protection in case of damage, and can be used for water ballast should it be found advisable to pin up harder than usual in some classes of digging. The coal bunkers are in the wing compartments abreast of the boiler.

The trusses above the deck extend the full length of the dredge and the stanchions and diagonals are secured to the longitudinal bulkheads. Stanchions and chords are double channel, latticed together.

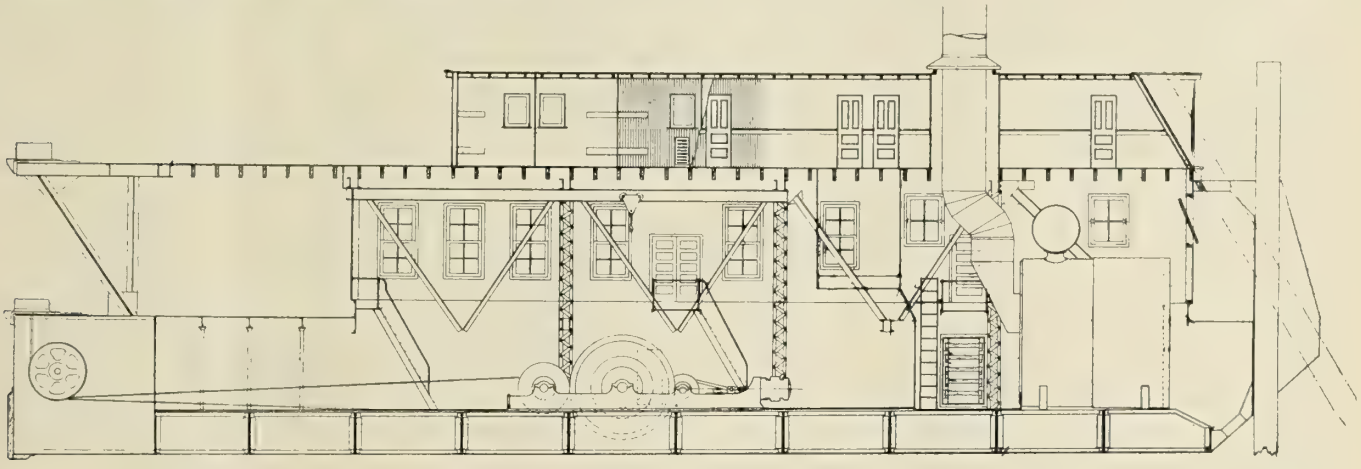
The spud casings are 44 inches square and extend to the top of the truss, to which they are fastened and braced. The forward end of the truss forms the foundation for the swing circle and A-frame.

There are two oak wale strakes on each side of the hull, with vertical pieces chocked between, spaced 9 feet, to take the roll of the fender log. There is in addition a fender at the forward end below the water, built of oak and faced with plate to take the shock if the dipper should be brought back against the hull.

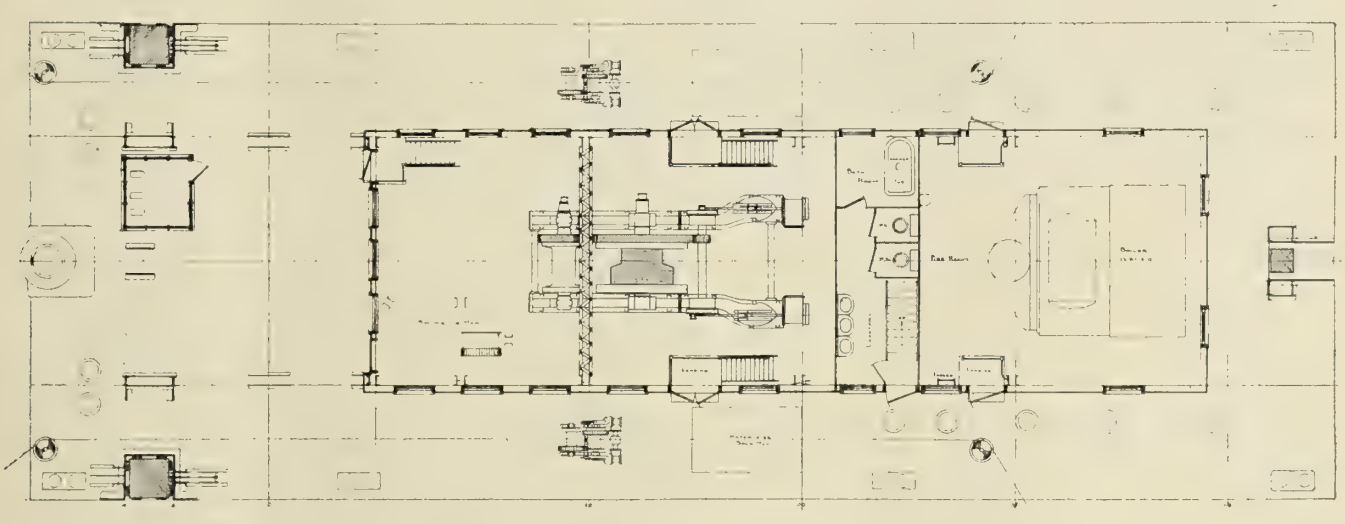
The forward spuds are 40 inches by 40 inches Oregon fir sticks in one piece, and the wear is taken by oak rubbing strips spiked onto all four sides, and which can readily be replaced. The after spud is 20 inches by 20 inches fir, operated by a rack and pinion.

The main engine is a double 16-inch by 18-inch engine, geared directly to a differential hoisting drum which is grooved to take wire rope. The same engine drives the backing drum, which also takes wire rope. The two drums are driven through outside band frictions actuated by steam cylinders. All the gears and the drums are cast steel.

The two spud engines, which are placed in the wing compartments, are 9-inch by 9-inch double-cylinder reversing



INBOARD PROFILE



MAIN DECK

engines, with steel drums and gears. A powerful steam-operated brake is provided on the intermediate shaft to hold the dredge when pinned up. The bed plates are of structural steel.

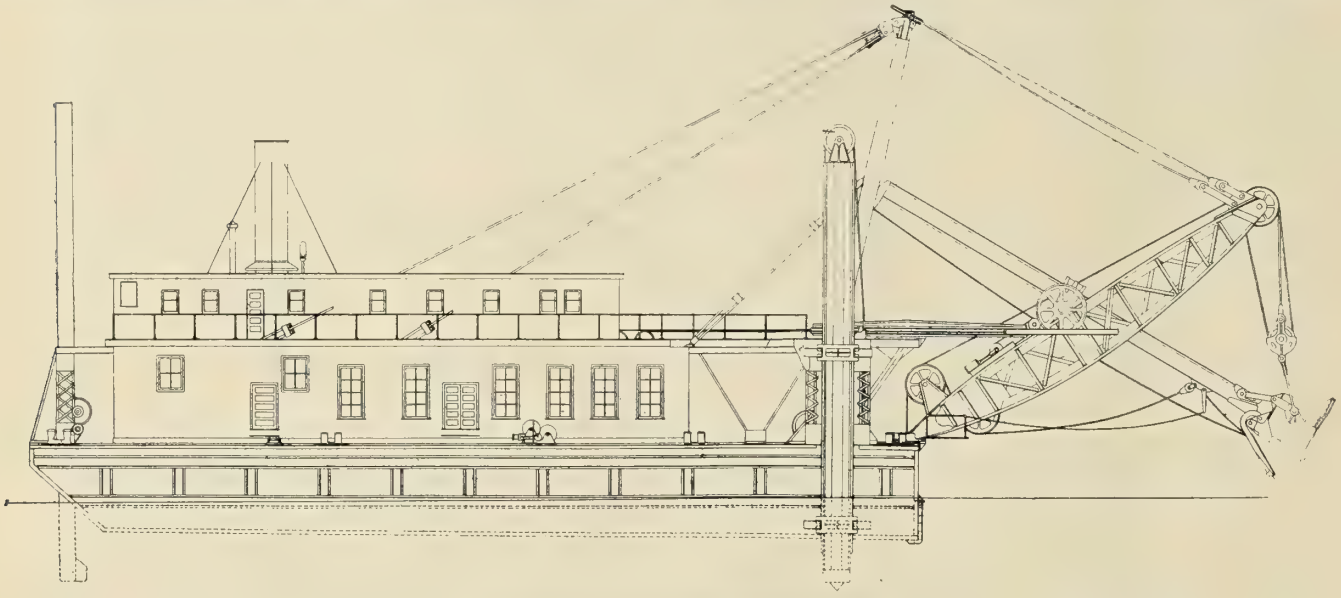
The swinging engine is a double 9-inch by 9-inch engine with cast steel drum and gears. The drum has double-threaded machined grooves for two parallel swinging ropes.

The boom, swing circles, A-frame, are of heavy structural steel, fitted with steel castings, and the various sheaves throughout are cast steel. The dipper, which is also supplied by the Bucyrus Company, is of heavy construction, provided with forged teeth and is operated by a steam dipper trip.

The stern spud is operated by a 9-inch by 9-inch center valve reversing engine which drives the spud hoist shaft by means of a chain and sprockets. The spud is raised by a pinion which meshes with a rack on the spud.

The operating levers are well forward on the dredge, situated in a small operating room, and control practically all the machinery.

The boiler is of the Scotch marine type, 12 feet 6 inches diameter by 12 feet long, built for a pressure of 150 pounds.



OUTBOARD PROFILE OF 8-YARD DIPPER DREDGE

There are two 50-inch Morison corrugated furnaces and 254 3-inch tubes. The boiler is further equipped with a 4-foot by 8-foot steam dome. The builders are the Manitowoc Boiler Works Company, Manitowoc, Wis.

The deck houses are built of wood, the roof of the lower house resting on the truss. This house completely encloses the machinery hatch and is lighted by large windows. The upper house contains all the sleeping rooms and the kitchen and dining room, and is ceiled throughout inside with yellow pine, varnished, and the quarters are light and roomy. The berths are all steel.

The lavatory is in the lower house and is equipped with modern plumbing, including a bath tub, shower, sanitary pump and water heater, and all the quarters are heated by steam.

For handling the scow lines there are two Chase double cylinder 6-inch by 6-inch tandem double drum winches with wire lines which lead around roller bearing fair leaders.

TANK STEAMER VESTA.—The Standard Oil Company's steamer *Vesta*, built by the New York Shipbuilding Company, Camden, N. J., was taken out April 5 for a trial trip on the Delaware River, meeting the requirements of her owners in every particular. The ship is 330 feet long, 46 feet beam, 27 feet depth and carries 30,000 barrels cargo oil. Before completion the vessel was changed to an oil-burning steamer.

Dredgers for Gold and Tin

Dredgers for recovering alluvial gold have been in use for many years. In our special dredging number of May, 1910, we published illustrations and an article describing the latest gold dredgers supplied by Mr. Arthur R. Brown, of 54 New Broad street, London, to various parts of South America, Africa, Russia and Siberia. Since that date the demand for dredgers for gold has very much increased, and many improvements have been introduced by Mr. Brown in the dredging machinery and gold-saving plant, so much so that his dredgers in Russia now work (in spite of severe frosts) practically the whole year round; those in the Urals have averaged 20 hours a day for 280 days per annum. The great advance made by Mr. Brown's dredgers will be better understood from a glance at the Russian Government returns, which show that the usual number of days worked in that country is only 170 days a year and about 15 hours a day.

The Lena district of Siberia has proved to be exceptionally rich in free alluvial gold, and very large returns have been received by the English shareholders of the well-known Lena Goldfields Company; so far these properties have been worked entirely by manual labor, the gravels being dug, raised in baskets and washed by hand.

Mr. Brown has just completed some large gold dredgers, which will be the first to be used in that district, and when they can get to work exceptional results are confidently expected. The transport, however, is very costly and takes time. The whole of the machinery has to be transported about 5,000 miles by rail, then about 300 miles by sledge, and then 800 miles by river. In order to insure the parts of the dredgers being transported by sledge before the snow melted, it was necessary for the whole plant to be shipped within three months from date of order. Although the dredgers were dispatched from England in February, they cannot arrive at their destination until about the middle of next June. In this district dredgers only have a possible 170 days for work, being frozen up the rest of the year, but it is expected that they will be in time to have a few weeks work this year.

Although dredgers have been used for many years for recovering gold and also for some time for platinum, it is only recently that they have been used for saving tin. They have proved most successful in saving this metal, although it is more difficult than gold on account of its lower specific gravity. A dredger for tin is constructed very much in the same

way as for gold, with the exception that the saving tables have to be much larger and more water is required.

The latest improved tin dredger, illustrated below, is at work near Penang in the Malay States. This dredger, which was built by Mr. Brown for the Malayan Tin Dredging, Ltd., of London, started work in January last, and although for the first month it was chiefly opening up ground, sufficient tin was recovered to leave a profit after paying all expenses of nearly $9,750 (£2,000). When, however, it gets into full work the net profit is expected to reach $19,500 (£4,000) monthly.

This dredger, which is the largest dredger for tin so far constructed and at work, has buckets of 10 cubic feet capacity and dredges to a depth below water level of 50 feet. The steel pontoon on which the machinery is placed is 150 feet long, with an elevator extending beyond the stern a further 116

IMPROVED TIN DREDGE AT WORK IN THE MALAY STATES

feet. A special feature of this dredger is that it is fitted with apparatus for removing the overburden and depositing it at a considerable distance behind the stern of the dredger, without passing through the screen or over the tables.

The motive power is steam and the engines are of a specially balanced type. The water supply for washing the material, as is necessary for tin, is exceptionally large, and the tables for saving the tin extend the whole width of the dredger and are 90 feet long.

Hydraulic Dredge Ithaca

BY R. R. ROANE, M. E.

The New York State Dredging Corporation, Rochester, N. Y., has completed a large 20-inch hydraulic dredge at Ithaca, N. Y., for work at a terminal of the New York State Barge Canal, known as improvements of the Cayuga and Seneca Canal, Contract "H," calling for 700,000 cubic yards of excavation and for the harbor work in connection with the barge canal at Ithaca, which calls for 62,300 cubic yards of excavation, making the total excavation 762,300 cubic yards.

The dimensions of the dredge are: Length over all, 137 feet 6 inches; beam, 40 feet; depth, 10 feet, and mean draft, 5 feet. There are two structural steel trusses running fore and aft for the whole length, the machinery being set upon steel foundations designed especially for the requirements.

The main pump and thrust bearing were designed and built by the Morris Machine Works, Baldwinsville, N. Y., the runner of the pump being 90 inches in diameter, of manganese steel. The pump is driven by a triple expansion engine 18 inches by 30 inches by 48 inches by 20 inches, designed by the New York Ship Building Company, Camden, N. J. This engine, while designed for 1,000 horsepower, is now being used only at a speed of 190 revolutions per minute with a cut-off of 66 percent of stroke, developing 750 horsepower.

Steam is furnished by four boilers, two of the Mosher watertube type, operating at 200 pounds steam pressure for the main engine and feed pumps alone, and two of the fire-tube Bigelow type, operating at 125 pounds steam pressure reduced to 100 pounds for all auxiliary machinery.

The dredge carries two main feed pumps 8 inches by 5 inches by 12 inches of the Blake vertical simplex type, a surface condenser of 1,750 square feet cooling surface, a main circulating pump 10 inches by 6 inches by 6 inches, an auxiliary circulating pump of the Blake horizontal duplex type 12 inches by 12 inches by 12 inches, an air pump of the Blake twin beam type 7½ inches by 15 inches by 10 inches, one feed-water heater and grease extractor, one filter tank, two water service pumps, one 6-inch by 6-inch by 6-inch vertical duplex Blake and one 8-inch by 5-inch by 12-inch horizontal simplex Blake, both connected in duplicate to supply the main engine water

20-INCH HYDRAULIC DREDGE ITHACA

service, the cutter engine water service, the fire line bilge system and for discharging ashes. There is an auxiliary feed pump for the auxiliary boilers and a Hancock inspirator; one fresh water pump 5¼ inches by 5 inches by 5 inches of the Blake vertical duplex type to draw from the scows and discharge to tanks, or vice versa.

The winding engines are of the Chase machine type with five drums. The ladder is of steel, designed by the Norbom Engineering Company, and the cutter engine is of the horizontal type designed by the Norbom Engineering Company, mounted directly on the ladder driving the cutter shaft through spur gears. The cutter blades, designed by the Taylor Iron & Steel Company, are of manganese steel.

LAUNCH OF THE UNITED STATES TORPEDO BOAT DESTROYER DUNCAN.—The United States torpedo boat destroyer *Duncan* was launched at the works of the Fore River Shipbuilding Company, Quincy, Mass., April 5. The vessel is one of eight contracted for by the United States navy in September, 1911, and is to be completed by September next. The keel was laid in June, 1912, and she will make her first preliminary trial trip about May 15, 1913. The *Duncan* is 305 feet long, 30 feet 6 inches beam, 17 feet depth, with a mean trial displacement of 1,010 tons. She carries a battery of four 4-inch guns and four 18-inch torpedo tubes. The propelling machinery, of 16,000 horsepower, consists of two 63-inch Curtis turbines and two compound, vertical reciprocating engines, designed to give the vessel a speed of 29 knots.

Dredging

BY M. G. KINDLUND *

In this article attention is to be paid principally to the methods in general use for attacking the materials to be dredged, or loosening them from the bottom, so that they may be brought to the surface for disposal. The methods employed are numerous and depend principally upon the nature of the bottom, and secondarily upon other conditions, such as depth of water and manner of transporting the spoil. As every dredging operation must necessarily include a study of the materials to be removed, it would be well to review the various soils that are ordinarily found, and note some of their characteristics, at the same time indicating the best means of dealing with them.

Mud, or silt, forming the bottoms of many rivers and harbors is composed of powdered mineral and vegetable matter, the mineral resulting from the disintegration of soft rock. It is easily carried in suspension by running water, and so is found at the mouths of rivers, where the slower current, or the encountering of tidal waters, allows it to deposit.

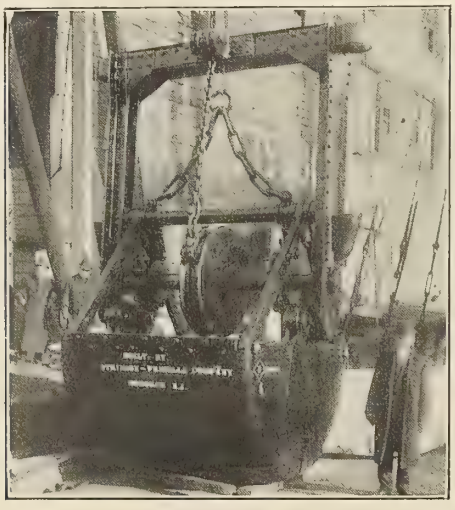


FIG. 1.—CLAM-SHELL BUCKET

Being more or less pasty in nature, the particles stick to one another during the course of removal, which facilitates handling when accomplished by an agency that does not stir up the bottom to too great an extent. However, once it is thoroughly stirred up, it takes a long time for it to settle again, often resulting in considerable loss of time. Layers of mud can be easily penetrated by a bucket, and as it is advisable, as before mentioned, to engage large quantities at one operation with little commotion, the grab bucket of fairly large capacity has been extensively employed for the purpose. The clamshell type of grab is the best, as it closes more effectively than the orange-peel and allows less leakage after being raised above the water.

Fig. 1 shows a clamshell bucket of about 7 cubic yards capacity, made by Atkinson-Frizelle Company for work in Havana harbor. It is a type very generally employed for dredging on the Atlantic Coast, and is constructed to stand the hardest kind of service. For mud the degree of penetrating power is not important, the main consideration being capacity and speed of operation. One evident feature of this method of dredging is that there is no limit to the depth of water; all other methods have limits set by questions of construction and obedience to Nature's laws, whereas, with the grab bucket, increased depth of digging may be provided for by more rope or chain and larger winding drums, the hull and engine remaining about the same for a given capacity. The bucket shown is of large size, weighing empty about 22,000 pounds, and filled with average material about 43,000 pounds. Clamshell buckets of the same kind have been built up to 12 cubic yards capacity, the principal difference in construction being the provision of two power wheels instead of one, not only to gain greater closing power, but also to overcome any tendency of the bucket to twist in raising and lowering. This 12-yard clamshell was built by Theo. Smith & Sons Company for the dredge *Finn MacCool,* one of the most powerful dredges in existence. This huge bucket weighed about 38,000 pounds empty and approximately 75,000 pounds filled with average material, requiring four 1¼-inch steel cables for its operation, wound on two 60-inch drums, the main hoisting engine being an 18 x 24-inch double cylinder engine, using steam at 125 pounds pressure.

Hydraulic suction dredges are often called upon to work on a muddy bottom. It would seem an ideal method, and is so if the suction head is designed to limit the water entering the pipe. The material goes into the suction quite easily, either with or without the use of cutters, but, during its progress through the pump and discharge pipe, the objectionable stirring-up of the particles of silt before referred to takes place, so that at the point of discharge the mixture resembles a black puree, that, unfortunately, remains a soup for some time. Gravity acts very slowly upon the light particles, and a portion of the material, sometimes a considerable portion, runs back into the river with the transporting water. Whether discharge takes place into the hoppers of the dredge itself or on the fill behind sheet piling, the same disadvantage is present. Thus, if 20 percent mud and 80 percent water enter the suction pipe, taking a favorable case, perhaps 5 percent or more will find its way back to the waters it came from, so reducing the economy of the operation by at least 25 percent.

Special suction heads are sometimes used for handling such slippery material, so designed that the mud is ploughed up and enclosed on top and sides; then water is supplied by artificial means only in sufficient quantities to make it possible for the suction to move the mass. It is really, then, a semi-solid mixture, in which the relative proportions of mud and water are often reversed as compared with the open suction pipe system. For a hopper dredge this method is ideal, but is obviously less applicable to cases where discharge takes place through long pipe lines. Unless some such device as this be used, it is often better to leave mud to a clamshell dredge, transporting it by means of dump scows. Of course a suction dredge may be profitably employed for reclamation purposes, where the area to be reclaimed is of large extent and sufficient time is given the released mixture to allow the solid portion to deposit before regaining the channel.

The next soil, as regards ease of handling, is sand, varying from the finest to the coarsest grained. It is very common to find mud and sand in the same locality, the preponderance of one or the other indicating the best means of dealing with it. In some rivers and harbors, and usually in the more open work of sounds and seacoast, sand is the material encountered. Owing to the comparative magnitude of such dredging operations—removing sand bars, making and maintaining deep waterways—the removal of sand assumes the greatest importance among the many duties of a dredge. Generally speaking, sand is formed by the abrasive action of fragments of

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hard rock grinding against one another in the beds of brooks and rivers and under the ever-moving waters of the sea shore. It is composed of fine quartz grains, usually mixed with other resisting minerals. The softer rocks are quickly ground into mud. When newly formed, the particles are angular and sharply pointed, and they may be classified as coarse or fine, according as the grains have been reduced to a large or small size.

For handling this material the hydraulic suction dredge stands without a rival, particularly where the quantity involved is considerable. Sand may be broken up quite readily with the aid of various devices to be described, although, when lying under deep water, the pressure packs it into a fairly solid mass. It lacks the cohesion of mud and clay, so a stirring-up process is comparatively easy and not objectionable, as the grains, being heavy, will quickly gravitate to the bottom of the hoppers or become stationary on the fill, leaving the transporting water free to find its way into the channel. When very fine sand is encountered it is a somewhat different story, owing to its lightness and consequent tendency to resist settling quickly. The grains become scattered very easily and float away, often giving as much trouble as silt, while lacking the cohesive qualities of the latter, when in bulk.

Of course any type of dredge will excavate sand under water, but there is none that will do it as economically and as expeditiously as the suction dredge. Sometimes nothing but the force of the suction at the end of the pipe is employed to release the sand, and under favorable conditions this does quite well. However, it is usually the best policy to fit some kind of an agitating apparatus, either mechanical or jets of water under pressure. The latter, used in connection with a special suction head, forms, perhaps, the most effective means of breaking up the material. The Government engineers, during their experience on the Mississippi River, have tried many forms of mechanical agitators, but have always come back to the water jets as offering the simplest and most direct means of accomplishing the result. Jets with 2-inch or 2½-inch nozzles supplying water under pressure of from 12 to 20 pounds by means of a centrifugal pump, seem preferable to small, high-pressure jets, although it is stated there is no appreciable difference in the efficiencies of the two systems.

Fig. 2 shows one form of mechanical agitator, or cutter, that is in general use for various soils, including sand. It has been found very efficient for all-round work. This particular one is an 84-inch cutter manufactured by the Norbom Engineering Company. Its object is to slice off portions of the material, which, falling between consecutive blades, are caught up by the suction and so removed. The shape and arrangement of the blades are not so important when working in sand, but they assume an immense importance when used in clay or other hard-packed material. The cutting edge is formed on the principle of a conical spiral, the section of the blades being designed to afford proper clearance in digging. The blades must be thick and heavily ribbed, for they are subject to enormous strains. They are bolted to a spider or hub, which imparts the rotary motion from the cutter shaft, and to a back or stiffening ring. The blades may be made of annealed cast steel, chrome steel or manganese steel, depending upon the degree of strength required.

In operation the cutter is revolved slowly while it is drawn into the bank by the swinging lines, the direction of rotation being from the bottom upwards, as regards the bank. This prevents any attempt on the part of the apparatus to climb up without doing useful work. Thus, when employed on radial cutting dredges, swinging from side to side on rear spuds, the cutter does its most effective work when making a swing in one direction, the return swing being made at a much greater speed and without much load. The swinging machinery should be designed to effect this without altering the engine speed to any great extent.

The speed of the swinging line may average 20 feet per minute when cutting, whereas twice this speed is desirable on the return swing, and it should sometimes be exceeded in order not to waste time. For dredges with 18 to 24-inch suctions, a line pull of 30,000 pounds is not too much to expect when working in packed material, and unless the ratio of gearing is properly determined on some such basis the revolutions of the engine will not be sufficient to develop the necessary power. An 8 by 10-inch double cylinder engine, geared 30 : 1 with respect to the winding drum, will give about 30,000 pounds line pull, with a 24-inch diameter drum, the engine turning up about 100 revolutions per minute. Greater engine speed would be preferable, but, as usually arranged,

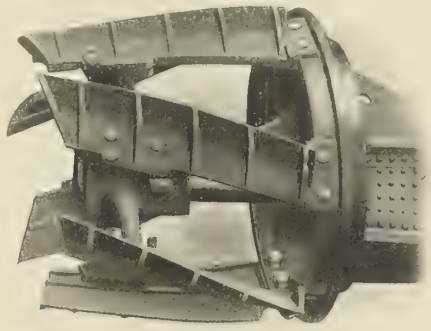


FIG. 2.—SUCTION HEAD

this is the best obtainable. On the light swing, however, the engine will speed up inordinately, unless the gearing be designed to limit it—say 50 percent more than when cutting.

A style of suction head in use by the United States Government Engineers on their work in dredging ocean bars is shown in Fig. 3. It is a sort of drag, fitted at the end of the suction pipe, one on each side of the vessel, provided with a scraper which tends to gather up the sand and force it into the mouthpiece. It is one of several that have proven themselves equally effective in one material or another, and is unique in that no agitator is applied beyond the scraping effect of the drag moving over the bottom at a speed of 4 or 5 knots. A very uneven bottom, or one where boulders are common, would tend to reduce greatly its efficiency. It seems to be admirably adapted, however, for work in exposed positions, where the soil is homogeneous and not too tenacious.

Many and varied, and indicative of great ingenuity, have been the devices proposed for the agitation of material to be dredged, and its introduction into the suction pipe. Thousands of dollars have been expended in testing them, the majority of which have not possessed sufficient merit to warrant their further use. Some have failed because they were too light and delicate to stand the severe service they were called upon to perform. Others failed owing to extreme weight and complexity of mechanism, that rendered them impracticable. Those that have survived are very few in number. In them the relative positions of cutter and suction mouthpiece have been carefully considered, as this is of equal importance to effective cutting alone. The solid material must be so directed that it will fall, or be projected, within reach of the suction. The influence of this suction rapidly diminishes as the distance from the end of pipe increases, and unless the slices of clay or masses of sand released by the cutter fall within the radius of this influence they might as well not have been cut at all. The force of the suction, or "suction head," varies with the velocity of flow maintained in the discharge pipe and indirectly with the depth of

water. The difference in weight of a column of water and an equal column of the mixture, whatever its specific gravity may be, is a factor in the loss of "suction head," together with the shape of mouthpiece and the frictional resistance in the pipe. The last two items are nearly constant for any depth of water.

machinery to furnish the stuff. With 22 or 24-inch pipe and a good rotary blade cutter, working in sand, this limit is reached at about 2,000 feet of discharge pipe.

Clay, and soils in which clay forms a considerable part, such as loam and some kinds of marl, often present more difficulties in their removal than any of the other soils. The

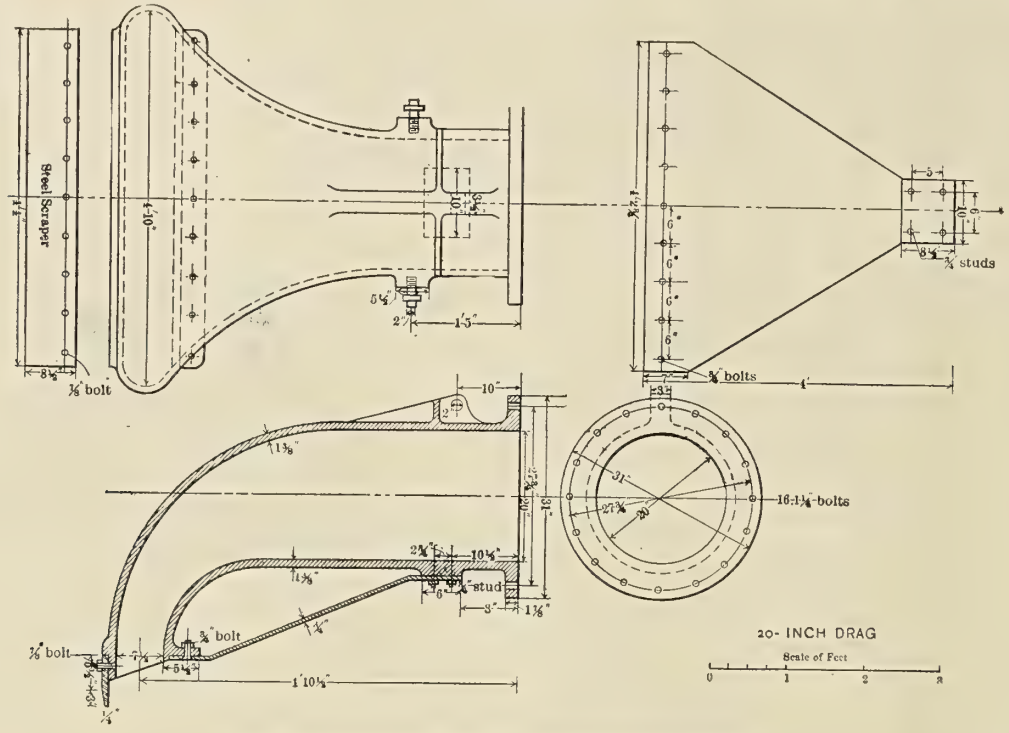


FIG. 3.—DRAG USED BY THE U. S. GOVERNMENT ENGINEERS

An unfortunate condition exists in this connection. Where the discharge pipe line is comparatively long, giving a high friction head, the velocity of flow is consequently reduced, which means a less powerful suction, and not so much material entering the pipe. So, in addition to consuming more power

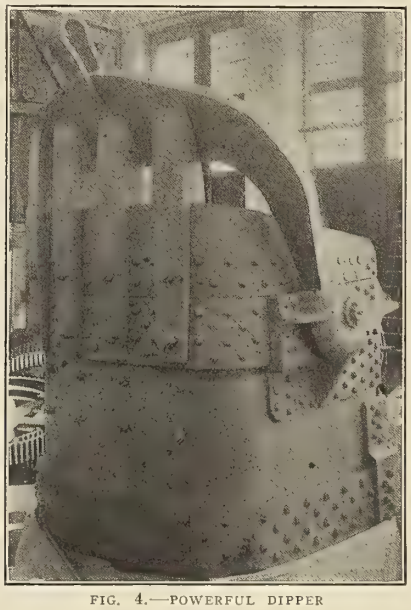


FIG. 4.—POWERFUL DIPPER

in the pump, long pipe lines give a smaller percentage of solids in the output. Any good cutting apparatus can supply the material for long lines, or, in other words, the current of water flowing in the pipe is usually "saturated"; but on shorter lines, where the velocity of flow is higher, the output is often measured by the ability of the agitating or cutting

tenacious characteristic, which is the chief one, renders this soil not only exceedingly hard to loosen from its bed, but it interferes with the efficient working of the apparatus, no matter which method is in use. It tends to clog the blades of the cutter on a suction dredge, and with any of the bucket dredge types the material adheres so persistently to the sides when discharging that much time is frequently lost waiting for it to become dislodged, or in employing some outside means for dislodging it. Dredges of the ladder bucket, dipper, and hydraulic suction types have all been successfully worked in clay where correct designs were used. In deep water, where the others were not suitable, grab buckets have performed valuable service, although, generally speaking, they are not to be recommended for clay, especially if of a hard sort.

For moderately shallow water the dipper dredge is particularly adapted to the handling of the harder varieties, as a glance at the records of dredging operations on the Great Lakes will show. This type, though not originated in this country, is distinctly American, for it is generally employed here, while comparatively few are used in other countries. Foreign engineers have evidently not considered them of enough value to replace their ladder buckets, and perhaps the nature of their operations justifies this opinion. The magnitude or extent of much of the dredging carried on in Europe probably makes it inadvisable to employ an intermittent type of machine, such as the dipper and grab bucket, in spite of their simplicity, effectiveness and small cost. In the United States dredging contracts are more scattered, usually less extensive, more varied in character, and often in restricted localities calling for a machine adapted to varied conditions and less unwieldy, and also less expensive, than the ladder bucket type. The burden of first cost and high maintenance charges are more than the average contractor cares to assume.

Fig. 4 shows a dipper of large capacity, as manufactured by the Bucyrus Company. It is especially massive in construction, and following the principle they adopted years ago, made to do its work without breakdowns, no matter how severely it is treated. It is surprising to note the enormous penetrating power of one of these dippers when provided with teeth. In the larger sizes the line pull may reach 200,000 pounds, and as this is often concentrated on one or two teeth, not only its digging power is apparent, but also the necessity of giving abundant strength. The teeth are made of manganese steel, the rivet holes being accurately cored in the casting. The pressure is taken by shoulders on them, bearing on a reinforced plate edge, thus sparing the rivets to a large extent. In no other type of dredge can as great power be directed to one spot, so that it has come to be regarded as without a rival for digging the most resisting materials. The dipper dredge has its counterpart on land in the steam shovel, universally used for excavating. It is an extremely serviceable machine for digging at close range, where it is not required to reach very far below its own level. On the Panama Canal scores of steam shovels, of large and small capacity, have replaced the old French continuous-chain-bucket machines, and some of the credit for the successful completion of the canal will surely belong to them.

With many kinds of machinery the strength of the various parts may be closely estimated by engineers, but in the case of dredging and excavating machinery generally experience is the only reliable guide. Profiting by years of successful and unsuccessful designs, the manufacturers of this class of machinery have accumulated a vast amount of data that they use for the benefit of the public. I say "the public," for engineering work of this character is very often in connection with public improvements, and contract prices are much lower when reliable machinery can be obtained than when the contractors are confronted with the probability of breakdowns involving the loss of time and costly repairs. Still, viewed from another standpoint, the public have paid for the countless failures that make up this experience, and should reap the benefit. A larger margin of profit was demanded by those undertaking difficult or uncertain work, and naturally the people stood the burden. It is the exception nowadays, rather than the rule, for machinery of this class to fail when the conditions are fully understood by intelligent designers, and the amount of hard usage and unskilled handling that it will successfully withstand is truly remarkable.

Hydraulic suction dredges, when fitted with clay cutters, are profitably employed on such work. Failures have often resulted in trying to make suction dredges dig clay, when proper cutting mechanism was not provided. Such a course is hopeless. There have been cases where not more than 50 percent of the required yardage was made, due solely to unsuitable cutters. It is an all-important detail to which too much attention cannot be given. This inability of the suction dredge to cope with clay of the harder varieties for a long time confined its field of usefulness to sand and other light soils. This idea still prevails in some localities and among those who have not seen a well-designed clay cutter at work. Once clay has been dislodged, however, it is very easily transported, causing little added friction and slight wear, and a larger percentage can be carried in the pipe than is the case with sand. It also seems to require less velocity of flow to keep it in motion; where 8 feet per second will transport clay, 10 feet per second is better for sand.

Hardpan, a dense stratum of soil, usually underlying softer soil composed of clay or gravel, sometimes interspersed with boulders, is exceedingly difficult to work. What has been said of stiff clay applies likewise to hardpan, with a little emphasis laid on the desirability of great power in cutting or penetration. The suction dredge, however, having reached its limit of effective work in stiff clay, is not generally considered suitable for hardpan, and where boulders abound it should not be considered. The European ladder bucket dredge and the American dipper are accorded first place. Both can attack the resisting surface with directness and power, and if stones present themselves they, too, can be taken care of. Naturally, the buckets of the ladder type, with a maximum of 1 cubic yard capacity, are less able to handle large boulders than a dipper of perhaps 12 to 15 yards capacity, with a lifting power of 100 tons.

At depths beyond the limits of a dipper dredge, say 50 feet, the clamshell bucket armed with strong teeth, or the orange-peel bucket, may be quite effectively employed in hardpan, provided they have enough weight to give penetrating power. Not only is this weight necessary in allowing gravity to act and produce momentum in the descending bucket, but the scooping effect, when the leaves of the open bucket are drawn together, varies directly with the weight. This penetrating

FIG. 5.—CLAM-SHELL BUCKET IN OPERATION

power is a fixed fraction or multiple of the weight for any one type and position of the scoops.

Fig. 5 illustrates a clamshell manufactured by the Hayward Company, of New York, in the act of closing through stiff material. If greater power were required, and the weight and construction of the bucket warranted it, the manufacturers provide another purchase by leading the flat link side chains over sheaves in the head, thus increasing the closing effect nearly 100 percent. There are several other methods of augmenting the penetrating power of the edges, such as enlarging the size of power wheel, thus giving greater leverage for the closing rope, and fitting multiple sheaves on upper and lower shafts, providing thereby as large a purchase as desirable. Buckets have been used where the opening and closing operations were performed by the positive action of compressed air, actuating a piston in a cylinder, wholly independent of the hoisting rope and the position of the bucket. The entire weight of this type is on the bottom while closing, there being no counteracting lifting effort, as with a closing rope. Another advantage claimed is the ability to close the bucket at any given depth, thus dressing off the bottom without excess excavation. An orange-peel bucket, such as shown in Fig. 6, has many advantages over the clamshell in hard digging, particularly where boulders or broken rock have to be handled, as the penetrating effect of the pointed leaves is obviously greater and the three blades either force the material inside the bowl or grasp any stones or other hard objects in their firm grip. Large power wheels assure ample strength in this grip. Another illustration gives a splendid idea of the manner in which a four-bladed bucket is capable of holding and lifting fragments of broken rock.

When gravel is encountered, composed of small, smooth pieces of hard rock, usually mixed with coarse sand, it is not a difficult problem for the contractor. Unless it has become very compact, any type of dredge will remove it. Hydraulic dredges, although not generally considered ideal for this class of material, have often been successfully employed on it. The wear on the inside surfaces of the pipe is considerable, and the noise coming from the interior, while gravel or shells are being transported, is like the rattle of musketry, but the work is accomplished.

The ladder bucket type is most efficient in this kind of dredging, combining continuity of action with large volume and very little loss of power, except that due to raising the material to a height sufficient to allow sliding into scows and the loss by friction, which is at all times a large item.

The removal of rock usually calls for special apparatus. When solid rock is encountered, fortunately not a common occurrence in dredging, it is necessary to resort to blasting

FIG. 6.—ORANGE-PEEL BUCKET

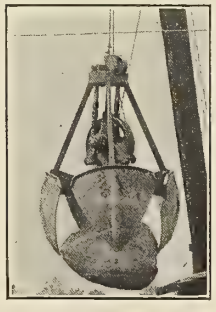


FIG. 7.—HANDLING ROCK

or hammering. The latter method consists in breaking the rock into small fragments by the repeated blows of a heavy weight falling a considerable distance, or by the hammering action of drills under a steam or air piston. Messrs. Lobnitz & Co., of Renfrew, have developed an efficient rock-breaking machine, employing the first system. A steel ram, fitted with a renewable point, conical in shape, made of hardened steel, the whole welghing in the neighborhood of 20 tons, is allowed to drop on the rock bottom repeatedly until the desired depth of penetration is reached. This series of blows is delivered at points about 3 feet apart, pulverizing a portion and breaking up the rest into fragments of a size that may be easily removed by dredging, using a style of bucket most suitable for the particular conditions.

Much of the sub-aqueous rock found is in a disintegrated state, due to mechanical and chemical action, and may be attacked at once by the dredging machines. As with hardpan, the ladder bucket and dipper dredges are most frequently employed. The buckets of the former type are run at as great a speed as possible, and, striking the soft rock with considerable energy, their steel teeth penetrate the material and bring fair-sized pieces to the surface. Of course, for this service the machine must be strongly built and be provided with ample engine power, for it is only a question of strength in the apparatus and of steam to overcome resistance. Advantage is taken of the weight of the buckets, as well as the tension in the chain, to accomplish this result. It is obvious that a ladder bucket dredge cannot be employed where the water is rough, as the waves would cause violent shocks to the ladder on account of its rigid construction. In rock dredging this limitation is especially imperative. In practice a wave height of more than two feet is considered dangerous. Stone grapples, ranging in capacity from 1 to 10 cubic yards, render good service for lifting rocks, as well as for ripping cribwork and pulling up stumps.

As indicated throughout this article, there are no clearly defined limits for any one type of dredge, all being suitable in many cases. Furthermore, even if one has an advantage over the others for a given piece of work, it is often impossible to employ it, as they are very expensive machines and one may not be available. So necessity has frequently forced the adoption of a type for operations a little out of its line, and the resourcefulness of the contractor has been taxed to find a way of using it economically. It is seldom that some method has not been devised to solve the problem, a tribute to fertile brains and the application of wide experience.

Dutch Suction Dredger

BY F. MULLER VAN BRAKEL

Though most dredgers are built with the sole purpose of removing material, some are constructed with the contrary purpose of collecting material—i. e., when the material has value in itself, as is the case with gold, tin, shells or gravel. Several of these dredgers are working on the rivers and on the coasts of Holland, bucket-gravel dredgers being used on the rivers Rhine and Waal, while suction dredgers are working on the northern coast dredging shells or gravel.

The latest gravel dredger was launched March 10, 1913, from the yard of Messrs. E. J. Smit & Son, Hoogezand, Holland. The vessel, which is being built to the order of Messrs. G. Doeksen & Sons, of Terschelling, had to meet the requirements of an efficient gravel dredger and also of a first-class seagoing tug.

The principal dimensions are:

Length over all	116 feet
Length between perpendiculars	105 feet 6 inches
Beam molded	18 feet 9 inches
Depth	10 feet
Block coefficient	0.507
Coefficient of load line	0.79
Coefficient of immersed midship section	0.793
Bunker capacity	60 tons
Forward trim tank	9 tons
Aft trim tank*	17 tons

The hull is built of mild steel to German Lloyd's highest coasting class, under special survey, with reinforcements in the bow for working in ice. Seven bulkheads divide the hull into eight compartments, i. e.: (1) Forward trim tank with chain locker; (2) officers' quarters, consisting of saloon and separate cabins for master and chief engineers; (3) boiler room with side bunkers; (4) cross bunker; (5) pump room; (6) engine room; (7) crew quarters; (8) trim tank.

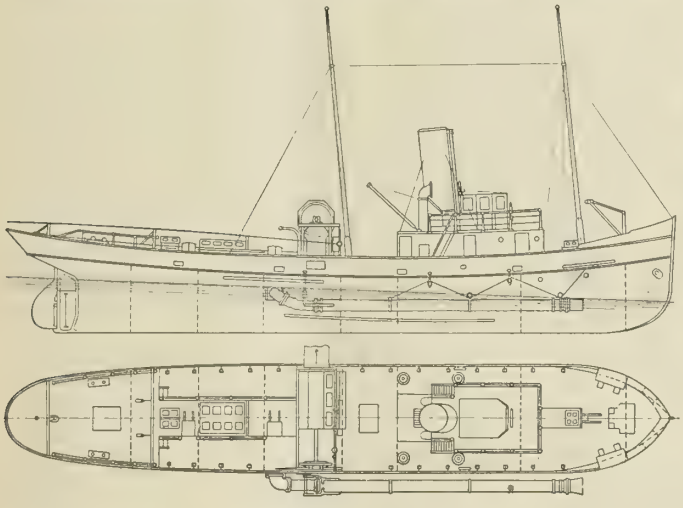
The body plan shows rather fine lines for the underwater body, especially aft, allowing an easy flow of water towards the propeller, and promising, in connection with the small beam, the best possible speed under given conditions. As the heavy revolving sieve, with steam engine, covers, chutes, etc., is placed rather high (about 12 feet above deck) a great initial stability is desirable. The load-line area was therefore designed as large as consistent with the limited beam. This produced another valuable property—i. e., strongly flaring out frames in the bow which will keep the propeller well under water when pitching in a heavy sea. Bilge keels are fitted to reduce the rolling movements.

Steam for all purposes is furnished at 200 pounds per square inch by a Scotch boiler of 1,200 square feet heating surface,

* Both trim tanks may be used as fresh-water tanks for boiler feeding.

having two Morison furnaces. The main engine is a triple expansion engine, surface condensing with Hackworth valve motion, capable of developing 340 indicated horsepower. By heavy clutches it may be coupled either to the gravel pump shaft forward or to the screw shafting aft. When the ship is to be used as a tug the screw shafting with clutches is replaced by a set of shafts with fixed flange couplings. Air, feed and bilge pumps are driven from the low-pressure crosshead.

The auxiliaries are installed in the engine room and pump room, and include a surface feed heater between the feed pumps and boiler, a feed-water filter between the hot well and feed pumps, a Thwaites centrifugal circulating pump direct connected to a steam engine (in addition to the condenser connection this pump is piped to the deck for salvage purposes and to the bilges), and a duplex Worthington steam pump with suction pipe lines to trim tanks, bilge suctions of all compartments except pump room, hot well and sea, and



DUTCH DREDGE VOLHARDING

with discharge piping to trim tanks, boiler check valves, deck service, condenser, stuffing box of gravel pump and to sea. There is also a Worthington duplex steam pump to keep water pressure on the stuffing box of the gravel pump. This pump may be connected to deck service, the after tank and the condenser. An ejector is supplied for emptying and filling the after trim tank in much shorter time than a steam pump is able to do. This may be necessary when the boat is to pass the shoals on the coast during bad weather. As soon as the shoals are cleared the after trim tank has to be filled again to keep the screws well under water. On deck are placed a powerful steam windlass for handling the anchors and suction tube, and a small compound steam engine for revolving the gravel sieve.

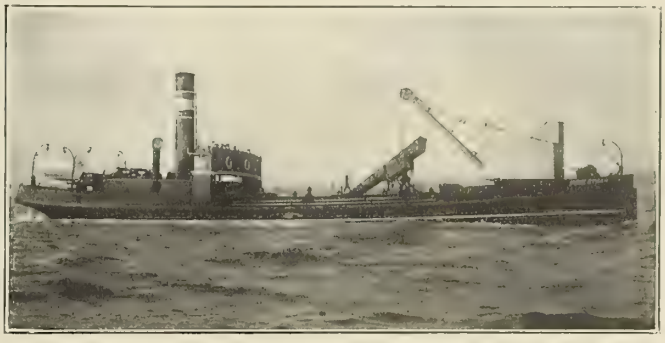
The 66-foot suction tube is carried on the starboard side and is connected to the inboard suction pipe by a rubber hose with steel spring strengthenings.

The gravel pump is of special design, invented by Mr. D. Doeksen. It is constructed of mild steel with cast steel reinforcements and heavy linings, of which a double set is supplied. By taking away one shaft between the crank shaft and impeller shaft, the pump can be opened by moving backward the whole of the front cover, the impeller with shaft and bearing, sliding along a pair of cast iron rails, thus laying open the impeller and pump for inspection or relining. The gravel pump discharges into a "shedding" box placed about 12 feet above deck, from which the material passes through a revolving sieve and is delivered to chutes on the port and starboard.

Earlier gravel dredgers deliver the finer and coarser gravel on the same side of the vessel, and therefore require one or two rubber conveyor belts to bring the two kinds of material to different sides of the ship. In this dredger the sieve and chutes are arranged in a way which delivers the coarse gravel on the starboard and the finer material on the port side without the use of conveyors, thus doing away with an expensive and troublesome apparatus.

Dredger Priestman

Until recently trouble has been experienced in securing an efficient dredge capable of meeting the demands for harbor work in Newfoundland. Not long ago the dredger *Priestman*, built by Smith's Dock Company, Middlesbrough, steamed out under her own steam from Milford Haven to St. John, where



DREDGER FOR HARBOR WORK IN NEWFOUNDLAND

she proved satisfactory in every respect for the work for which she was intended, and she was accepted by the Newfoundland Government. The *Priestman* is 127 feet 3 inches long, 26 feet 6 inches beam, 11 feet 3 inches depth, with a draft of 10 feet. The vessel has a speed of 8½ knots and, as can be seen from the illustration, one grab dredger is provided giving the dredge an output of upwards of 110 tons per hour. The capacity of the hopper is 325 tons.

Grab Dredger North Western

Messrs. Ferguson Bros., of Port Glasgow, recently supplied to the London & Northwestern Railway Company, for work-

GRAB DREDGER BUILT FOR THE LONDON & NORTHWESTERN RAILWAY

ing at the Gaston Docks, a self-propelling hopper dredge with a capacity of 1,000 tons and equipped with four grab dredges, capable of giving the dredge an output of 600 tons per hour. The dredge is 195 feet long, 26 feet beam and 16 feet depth.

Two 15-Yard Dipper Dredges for Panama

In order to open portions of the channel of Gatun Lake, to dredge the canal proper, and to pick up the slides that are bound to be slipping into Culebra Cut for some time to come, the Isthmian Canal Commission have recently ordered of the Bucyrus Company, South Milwaukee, Wis., the two largest dipper dredges that have ever been built. These dredges are duplicates and follow very closely in design the Bucyrus dipper dredge *Toledo,* owned by George H. Breyman & Brothers, at work in Boston harbor. This dredge was very thoroughly described in the 1912 dredge number of INTERNATIONAL MARINE ENGINEERING. The advance in high-powered dredge construction, based upon the operation of the *Toledo,* which is the largest dredge of this type ever constructed, and the adaptation of the design of the *Toledo* to the conditions to be encountered at Panama should prove of more than ordinary interest to engineers.

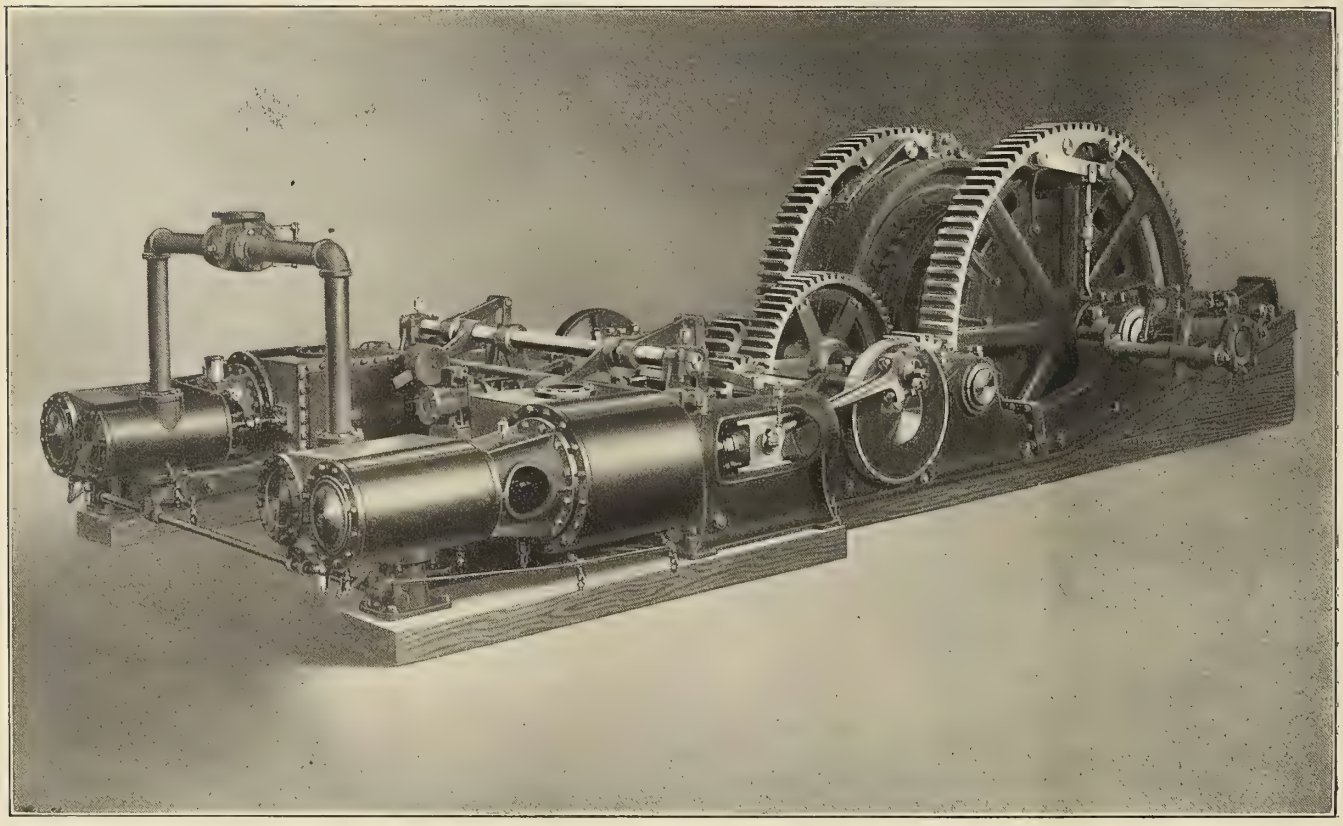


FIG. 1.—HOISTING ENGINE AND DRUM

The greatest difference between the two designs is to be found in the steel hulls with which the new dredges will be equipped. This, of course, makes a far stiffer and stronger dredge than a wooden hull could possibly do.

The dredges will dig to a depth of 50 feet below the surface of the water, and are of the single part wire rope type. Their hulls are to be 144 feet long by 44 feet in width, 16 feet 6 inches deep at the bow and 13 feet 6 inches at the stern.

The main engines illustrated in Figs. 1 and 2 are horizontal twin tandem compound condensing, with cylinders 16 inches and 28 inches in diameter by 24-inch stroke. The valves, which are operated by the Stephenson link motion, are of the piston type on the high-pressure cylinders and flat slide double-ported balanced type on the low-pressure cylinders. As may be seen in Fig. 1, the engines are compound geared to large spur gears on either end of the hoisting shaft which carries the drum. This is cast steel of the differential type and is grooved for 3¼-inch wire rope. This shape gives the maximum digging power and the slowest speed at the time when the dipper is digging, and the angle between the hoisting rope and dipper handle is sharpest. As the dipper emerges from the material the rope reaches the larger diameter of the drum, thus gradually increasing the speed at the expense of the power when this is most desirable. In these dredges the small diameter of the drum has been increased over that of the *Toledo* with the view of lengthening the life of the rope. This, of course, has necessitated changes in gear ratio over the older dredge. The drum is mounted loose on a forged steel hoisting shaft, the power is applied through two outside wood-lined band frictions, one on each side of the drum of special design. These frictions are operated by a steam-actuated thrust cylinder shown in Fig. 2. The device has proved very successful—indeed, it seems to be the only type which will take care of the enormous power of the engines.

The swinging machinery is operated by an independent single expansion double engine of the link reverse type, having cylinders 12 inches in diameter by 16-inch stroke. It drives a cast steel cylindrical swinging drum which carries two swinging ropes leading to the circle.

The swinging circle is of structural steel 24 feet in diameter, similar to the *Toledo's,* which is shown in Fig. 3. The dipper is hauled back by means of an independent, horizontal, double-cylinder, single expansion engine geared directly to a cylindrical drum.

The spud machinery is a departure from the *Toledo* design. On the Panama dredges the hoisting and lowering of the for-

ward spuds is to be through four-part hoists. The engines are to be connected directly to the drums by friction clutches, so that they may be readily disconnected for lowering. On the *Toledo,* as on other dipper dredges, the spuds were driven through a two-part hoist and the drums were driven by jaw instead of friction clutches. In the past the practice has been to place the spuds on the corners, which limits the swing of the boom to 120 degrees. Lately there has been a demand for a swing of 180 degrees. So, in order to take care of this on the new dredges, the spuds have been moved back from the corners. Furthermore, it has been found desirable to exert

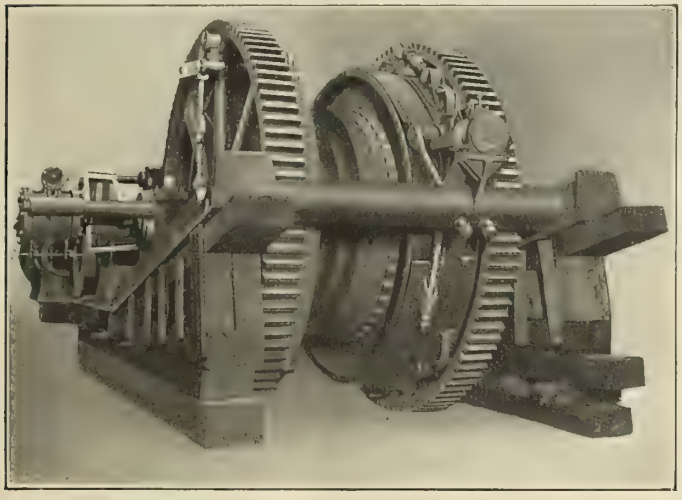


FIG. 2.—HOISTING DRUM, SHOWING THRUST CYLINDERS WHICH OPERATE THE FRICTION AND BRAKE BANDS

the full power of the engines with the boom swung to the limit. With the old arrangement this was impossible, hence a radical departure was necessary.

The stern spud machinery has also been considerably changed. In the past the common, though not the invariable, practice has been to operate the spud by means of a wire rope attached to the foot of the spud. This type is in very general use on the Great Lakes, and has been found very satisfactory for depths not exceeding 30 feet. Where the digging runs 50 feet deep the increased weight caused by the length and size of the spud often causes the operator to allow it to fall too fast when lowering. The tremendous momentum thus developed is apt to tear out the fastenings when it is attempted to break the fall. This naturally causes considerable delay, as it is generally necessary to employ a diver to do the repairing. On the new dredges, therefore, the stern spud, which is of the trailing type, is hoisted and lowered by a rack and pinion drive. All three spuds are of steel construction. The forward spuds are 48 inches square and 72 feet long and the stern spud 30 inches square and 80 feet long. The spud feet are collapsible, so as to facilitate raising.

The boom is to be 62 feet long, built of steel of the solid plate girder type. The boom sheaves are heavier and larger than ever before used. The dipper handle is of the usual construction, built up of Oregon fir reinforced with heavy bars and plates. It is 72 feet in length. The racks are of Bucyrus nickel chrome steel, heavily shrouded.

The dredges are to be supplied with two dippers, one of 15 cubic yards and one other of 10 cubic yards capacity. The latter is extra heavy for rock work and is equipped with teeth. The dippers are to be tripped by a steam cylinder mounted on the boom.

For moving scows two three-drum winches are supplied. These are located on the main deck, one on each side of the house. The engines, which are inside the house, are each a 6-inch by 6-inch horizontal type engine.

The steam plant on each dredge is very complete. Two Scotch marine boilers provide the steam; each boiler is to have two Morison suspension furnaces. A condenser with an air pump and a centrifugal circulating pump driven by an independent engine is supplied, and there is a closed feed water heater, feed pumps, two fresh-water tanks built into the stern and a complete electric light plant. Both dredges are to burn either coal or oil, so two large oil storage tanks are provided as well as coal bunkers.

The dredge is built especially with a view to rapidity of work and convenience in operation. Wherever any force is

FIG. 3.—A VIEW OF THE SWINGING CIRCLE, BOOM, SLIPPER SHAFT AND DIPPER HANDLE

required to operate a lever, the lever in the stand simply operates the valves of the steam cylinder which is connected with the lever mechanism. Thus these big dredges are easier to operate as a one-yard dredge. The entire dredge is operated by four men—the dredge runner, the cranesman, one fireman who operates the stern spud, and the man in charge of the scow winches.

The output of the dredge should vary between 500 and 600 cubic yards an hour when working fairly steadily. The *Toledo* has often made 9,000 cubic yards of hard sand in fifteen hours. Delays of various sorts would, in the natural course of events, frequently cut this down to an average of between 3,000 and 4,000 cubic yards a day.

The dredges are both to be erected at Newburg on the Hudson, and the preliminary test is to be made there. They will then be towed to Panama, where the final test will be held.

New Hydraulic Dredge Niagara

The Duluth-Superior Dredging Company, of Duluth, Minn., are having built a 20-inch hydraulic dredge which may safely be said to be the heaviest and most powerful of its size ever constructed. It is particularly interesting, as it marks another stride in the hydraulic dredge design into the field which has heretofore been held by the dipper and elevator dredge.

This dredge, named the *Niagara*, will be used on the Saginaw River, where this company has a large Government contract. Last year this company operated their hydraulic dredge *Enterprise* on the same project, but found it advisable to use two plants the coming season.

The *Niagara* is just receiving the finishing touches at the yard of the Manitowoc Shipbuilding & Dry Dock Company, Manitowoc, Wis., the company which designed and built the hull. The machinery was supplied by the Bucyrus Company, of South Milwaukee, Wis.

The hull is 135 feet long, 43 feet wide and 11 feet deep. Two watertight longitudinal bulkheads run continuously from end to end and there are also three watertight athwartship bulkheads. The coal bunkers are in the side compartments below the deck abreast of the boilers, and there are also two bunkers alongside the single boiler.

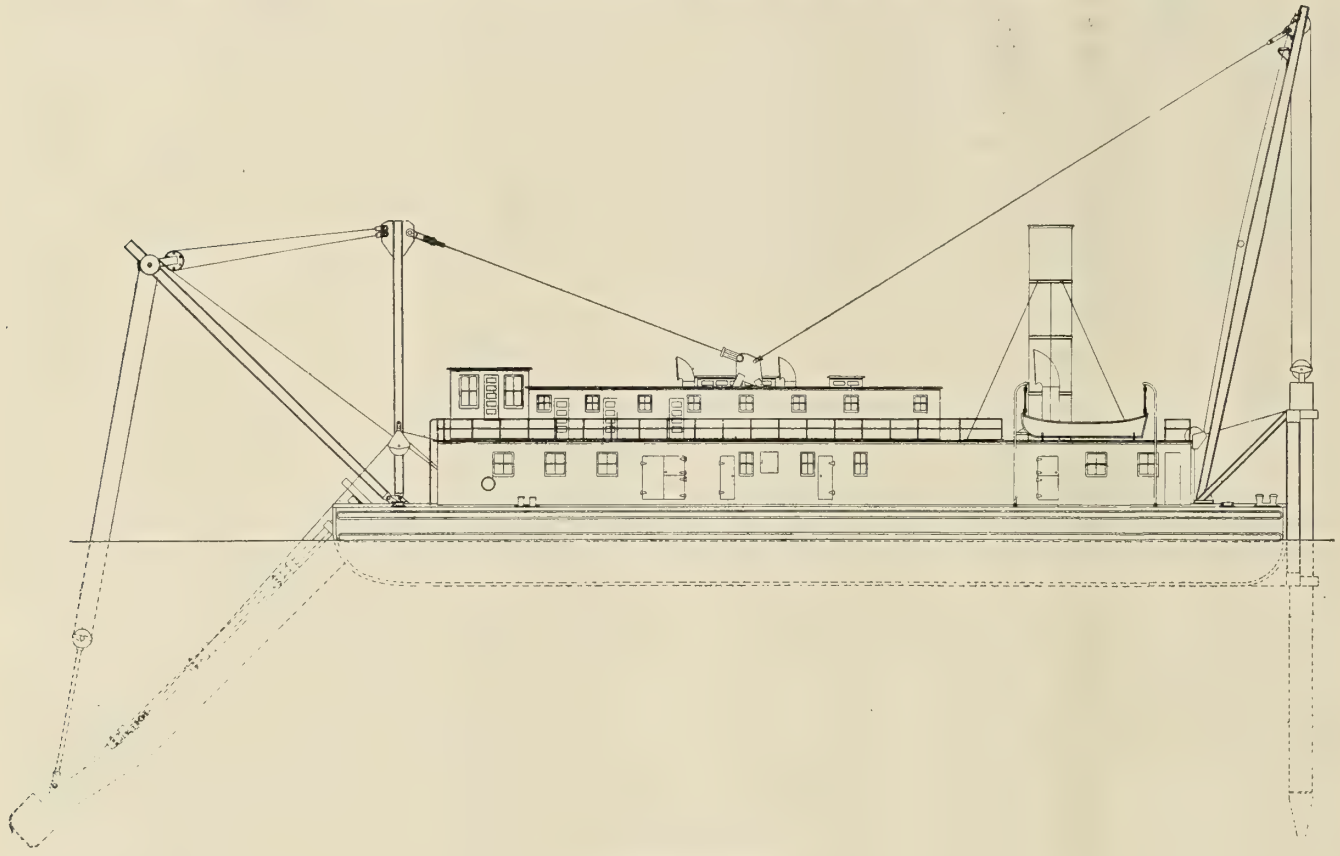


FIG. 1.—OUTBOARD PROFILE

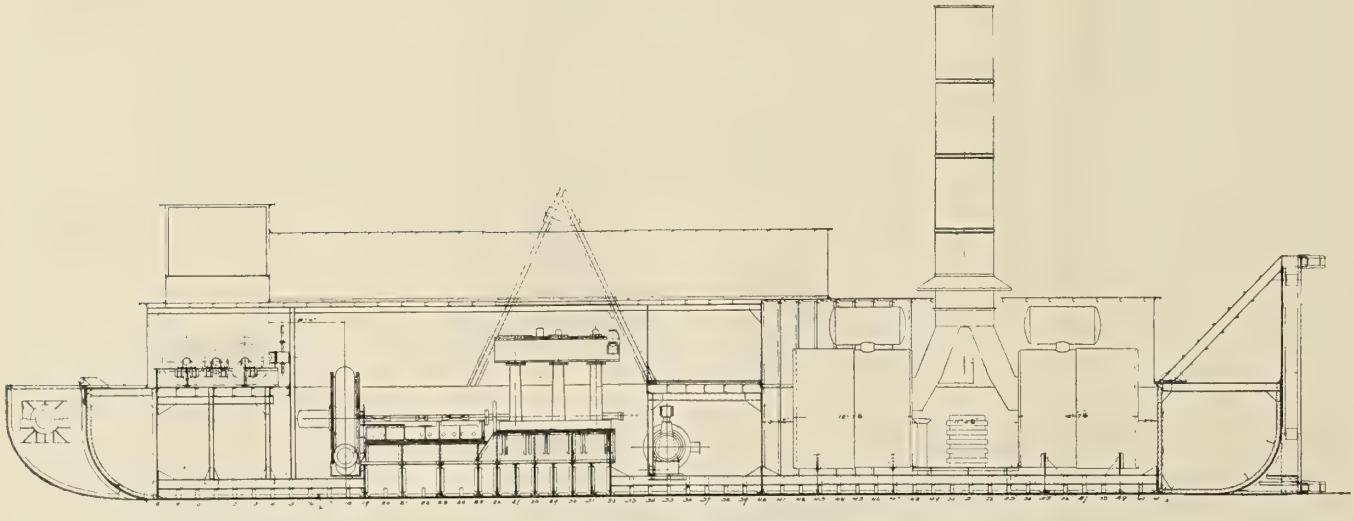


FIG. 2.—INBOARD PROFILE (ENLARGED)

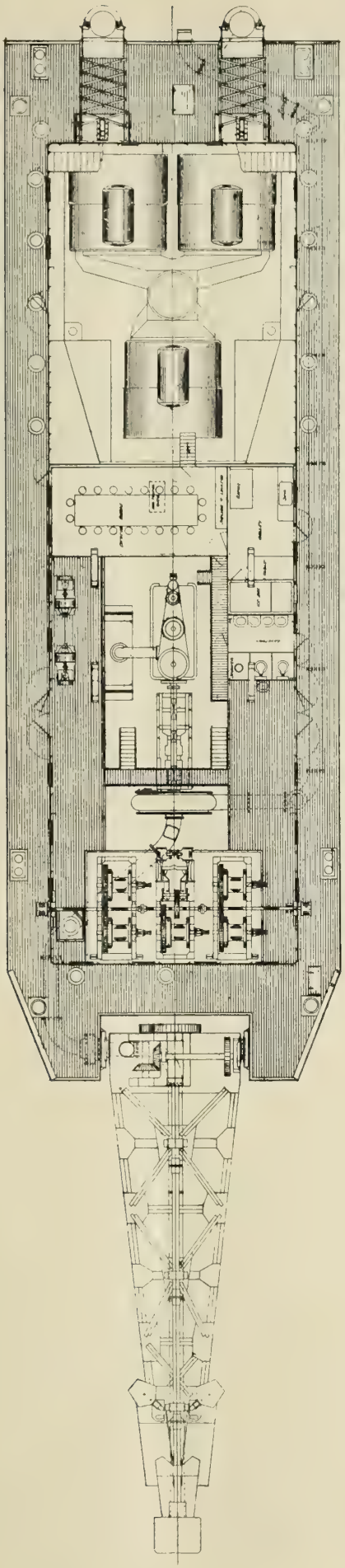


FIG. 3.—MAIN DECK, SHOWING ARRANGEMENT OF MACHINERY

The engine and pump are placed on a massive foundation built on a series of high floors, extending across the hull, to minimize vibration. The ladder well at the forward end is thoroughly braced and the shell plate is 5/8-inch thick in this vicinity. There are two wale strakes on each side of the hull formed of corrugated plate packed with oak. The deck is covered in all the exposed places with 4-inch by 4-inch fir decking, bolted to the deck plate and calked.

The pump is driven by a 1,000 horsepower triple expansion vertical marine type engine, built by the Marine Iron Works of Chicago, Ill. This engine develops a speed of 200 revolutions per minute and has enough power to pump the material through a 5,000-foot pipe elevated to a height of 10 feet above the water. The dredge is designed for digging unusually hard material; the pump, therefore, is of extra heavy construction throughout, in order to take care of the unusual wear and of the very high water pressure. Exclusive of the engine it weighs 71,000 pounds; the runner is 100 inches in diameter. Both these parts, together with the pump heads and the cutter

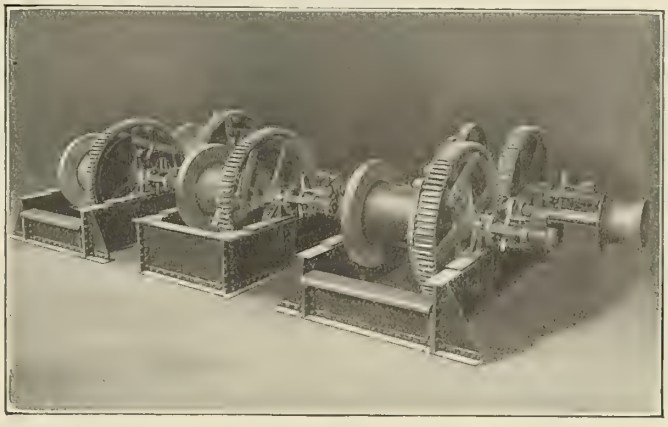


FIG. 4.—FIVE-DRUM WINCH

head, are of the special Bucyrus nickel chrome steel, which has given such splendid results in the unusual heavy wear imposed upon it in placer dredges. The casing, in accordance with the modern method, is unlined.

The cutter-drive machinery is undoubtedly the heaviest and strongest ever before used on this size dredge. The engine is double cylinder, 12 inches by 15 inches, of extra heavy construction throughout in order to enable it to run at a full boiler pressure of 200 pounds per square inch. The gearing is of extremely large and heavy design, with the teeth cut from the solid. The cutter shaft is 10 inches in diameter on the upper end and increased at the lower end, where it fits the cutter head to 11½ inches in diameter. Another unusual feature indicating the tremendous strength of the machine is the fact that the gearing on the top of the ladder is mounted on a single cast steel bed plate, which, it is claimed, absolutely insures rigidity under the most trying conditions.

The weight of the cutter drive machine is about 52,000 pounds. The cutter head is also a very unusual design. It is of the six-bladed type, made of nickel chrome steel. The blades, however, are equipped with teeth fitted into sockets, whose function is to disintegrate the hard material it doubtless will encounter. These teeth are arranged so as to alternate, three on one blade and four on the next.

The suction ladder is of the plate girder type, extra heavy, weighing 77,000 pounds exclusive of the machinery. The spuds are 39½ inches outside diameter and 67 feet in length. They are built of lap-welded steel pipe ¾-inch thick and are fitted with cast steel spud points.

The winch is of the usual five-drum type illustrated in Fig. 4, and the rest of the fittings, the A-frame gantry, etc., are all exceptionally heavy, to conform with the rest of the design.

The boilers, of which there are three, are 12 feet 6 inches diameter by 12 feet long, each with two 48-inch Morison corrugated furnaces and a 48-inch by 8-foot steam drum. The boilers were built for a working pressure of 200 pounds and were furnished by the Manitowoc Boiler Works Company.

The engine room equipment consists of a surface condenser with an independent pump 10 inches by 16 inches by 18 inches, an 8-inch Wheeler volute pump direct connected to an 8-inch by 8-inch Sturtevant engine, two 8-inch by 5-inch by 12-inch Dean Bros. boiler feed pumps, two 7-inch by 4½-inch by 10-inch Dean Bros. general service pumps, one 4-inch by 4-inch by 5-inch Burnham sanitary pump and an American Steam Gauge Company 4-inch grease extractor. The electric lighting equipment consists of two 10-kilowatt Allis-Chalmers generators, direct connected to A. B. C. engines. Trolleys over the main engine and the pump facilitate the overhauling of the cylinders and pump runner.

A two-story deck house covers the machinery and boilers and is built entirely of steel. The lower house contains the kitchen, with a large icebox, the dining room and the crew's wash room. The upper house is devoted to sleeping rooms for thirty-six men; also the officers' wash room and bath. The quarters throughout are ceiled in varnished yellow pine and have maple floors, and all the rooms are heated by steam.

The dredge is lighted throughout by 140 electric lights, and a search light is installed on the roof of the operating room. This operating room is in an elevated position forward of the upper house, and the provision of many large windows gives the operator an unobstructed view of the work.

The Bucyrus Company has done much in developing the hydraulic dredge to the point which it has now reached. A few years ago one would never have dreamed it possible that a hydraulic dredge could dig anything but sand, loam and the softest clays. In the construction of the barge canal in New York State, however, it was necessary to develop a type of dredge that could dispose of material at some distance from the digging point and at the same time be able to handle unexpected streaks of cemented gravel, boulders and other hard material. This is what led to the design of the 20-inch Bucyrus hydraulic dredge, which has made such a splendid name for itself. The Duluth-Superior machine is the latest development of this type, and for this reason it should prove of unusual interest to the engineering world.

Tyne Improvement Dredger

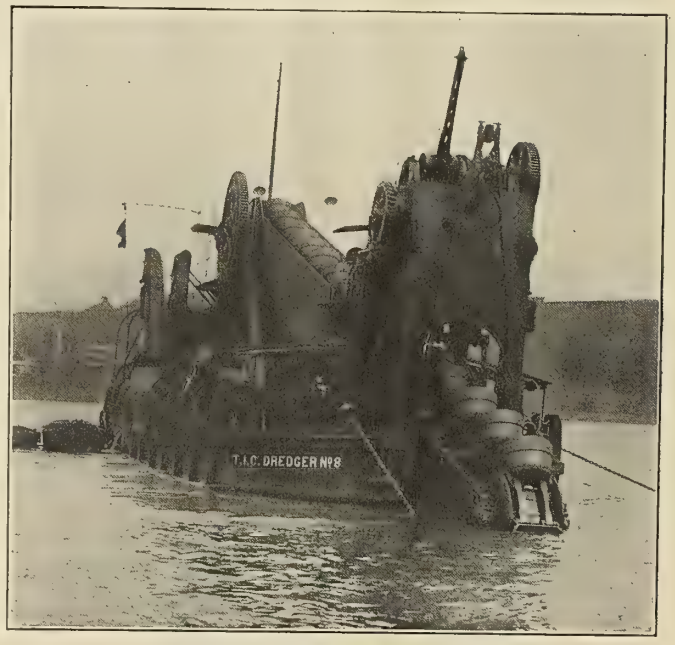
BY F. C. COLEMAN

The illustration shows a bucket dredger which has been built by Messrs. Fleming & Ferguson, Ltd., to the requirements of the Tyne Improvement Commission and under the direction of Mr. N. G. Gedye, M. Inst. C. E., the Commissioners' chief engineer. The dredger, in addition to being suitable for dredging close up to quay walls, is non-propelling, of the bow-well, bucket-ladder, barge-loading type, and her dimensions are as follows: Length, overall, 147 feet; breadth, molded, 30 feet; depth, molded, 12 feet. She is capable of raising 600 tons of material per hour from a depth of 45 feet, and of dredging to a depth of 35 feet close up to quay walls. Side shoots are arranged for discharging the dredged material over either side into hopper barges, the shoots being raised and lowered by an independent steam engine.

The vessel is built of Siemens-Martin mild steel plates and angles in excess of Lloyd's 100 A. I. class and under their special survey. The hull is subdivided into twelve watertight compartments by means of steel bulkheads, all carried up to the main deck. The accommodation for the officers and men is conveniently arranged and fitted with all necessary requirements for the comfort of the crew. Heavy beltings and strong vertical fenders are fitted along the sides of the vessel to take up the wear and shock of hopper barges when approaching and lying alongside the dredger in heavy weather.

The engines for working the bucket gear are of the vertical compound surface condensing marine type with steam reversing gear, etc. The gearing between the engine and tumbler shaft is of cast steel, with machine-cut teeth, and arranged to give four speeds at which the buckets can be worked to suit the varying nature of the materials to be dredged. The chain of buckets and links are of strong design and heavy construction for working in rock or boulder clay.

The bucket ladder, of Siemen's steel, is built of heavy scantlings in accordance with the builders' latest improved design, the riveting throughout being done by hydraulic machines.



DREDGER MOORED FOR OPERATION

The lower tumbler and the rollers on the top of the ladder for guiding the buckets are fitted with the builders' patent lubricated bearings, which exclude the sand and water from the bearing surface. Three of the builders' special mooring winches are fitted for manipulating the mooring chains while the vessel is at work, all the barrels being worked independently by means of patent friction clutches.

The hoisting machinery for lifting the bucket ladder is fixed on the fore framing and drives direct the large grooved barrel on to which the wire ropes are wound. Special provision is made, so that, should the main ropes break and the ladder fall to the bottom, the preventer ropes which are led up the ladder can be coupled direct to the barrel and the ladder raised without loss of time. A 5-ton crane is fitted on deck for overhauling the buckets, etc.

Steam at 160 pounds pressure for operating the dredger is supplied by a single multitubular marine boiler. A very complete installation of electric light is fitted for night working, the lamps being of the metallic filament type. The dredging craft belonging to the Tyne Improvement Commissioners now consists of 5 dredgers, 14 steam hoppers, 20 dummy hoppers and 5 steam tugs, and as affording some illustration of the improvement which has been effected in the waterway it may be mentioned that during the period from 1850 to Dec. 31, 1911, no less a quantity than 128,566,360 tons of material were dredged by the Commissioners from the river and taken to sea, and that during each of the twelve years from 1900 to Dec. 31, 1911, an average quantity of 2,002,407 tons were dredged from the river and taken to sea.

Performance of Ellicott Dredge Wahalak

No more striking example in the evolution of machinery can be found than the efficiency of present-day pipe line dredges over the dredges of twenty years ago.

In 1893 the United States Government entered into contract for dredging in Charlotte harbor, Florida, at a price of 74.4 cents (3s. 1.2d.) per cubic yard for scow measurement, equivalent to about 60 cents (2s. 6d.) measured in place. Contracts varying from 20 to 60 cents (10d. to 2s. 6d.) have been made from time to time for dredging in the different harbors on the Atlantic, Gulf and Pacific coasts. That the contracts paid well is proven by the existence of many wealthy dredging companies which have made Government work a specialty. Of this there can be no doubt, but in former years contractors were limited in their profits by the inadequate machinery then in use.

VIEW OF ELLICOTT DREDGE, SHOWING ARRANGEMENT OF MACHINERY

The contract for work in Charlotte harbor, Florida, referred to was annulled and a plant rented at $333.33 (£68.5) per day. This plant worked thirty-five days at a cost of $12,666.51 (£2,600) and removed only 36,982.5 cubic yards, making the cost 34½ cents (1s. 5.25d.) per cubic yard, removing only an average of 122.46 cubic yards per hour. The work accomplished and cost per cubic yard of the work of the dredge *Wahalak*, built by the Ellicott Machine Corporation, Baltimore, Md., for the United States in 1910, presents a startling contrast. For twelve months, working in Mobile harbor, Alabama, this dredge made an hourly average of 574.9 cubic yards at a gross cost per cubic yard of 3.24 cents (1.625d.)—a cost of 31.26 cents (1s. 3.625d.) less per cubic yard than that of the dredge in Charlotte harbor. This shows the effect of the evolution in dredging machinery.

The dredge *Wahalak* is but one of a type of a large number of successful dredges built by this firm for the United States Government, as well as for private corporations in this and other countries. Much of the machinery was originated by the Ellicott Machine Corporation as a result of many years of study and experience. This dredge is of the following dimensions: Length overall, 150 feet; width, 40 feet; depth, 11 feet 6 inches. The hull is built of steel throughout and is divided into four watertight compartments by means of transverse bulkheads, and is stiffened by two fore and aft bulkheads.

The superstructure is of wood and consists of a house over the main deck, which covers all machinery. The living quarters, etc., are placed above the main house and consist of pilot house, in which is placed the operating appliances; aft of the pilot house are the officers' quarters, galley, mess room, etc. All windows are screened, thus minimizing danger from malaria-infected mosquitos.

The pumping machinery consists of one centrifugal pump of the side-suction disk-lined type, constructed of steel and so designed as to withstand shocks due to the passage of stones, etc., which are often encountered in dredging. The pump is directly connected with the main engine shaft, all thrust being taken care of by marine thrust bearings. The main pumping engine consists of a three-cylinder triple expansion 14, 22½ and 40-inch by 20-inch vertical fore and aft condensing engine, which averaged 145 revolutions per minute during a year's work.

The agitating machinery is located at the bow of the dredge on a steel ladder of framework, resting on heavy steel trunnions. The suction pipe is carried on this ladder, the depth of the cut being regulated by raising or lowering the ladder. The agitating engine is located also on this ladder at its inboard end, and consists of a double condensing engine especially designed for very heavy work.

The boiler plant is the result of years of study, and consists of four wet back Scotch marine boilers, 10 feet 6 inches long by 11 feet 4 inches in diameter. These boilers may be worked in battery of three, reserving one for emergency, and may be operated with either coal or oil as fuel.

Just forward of the engine room is located the pump room. Besides the main pump, the fire pump is also located in the pump room; this pump serves to operate an improved ash ejector in addition to its use as a fire pump. A modern refrigerating plant is installed on the lower deck, which provides a cold storage room, besides making more than sufficient ice

for the use of the entire plant. This dredge is also equipped with an electric plant, which provides current for all exterior lighting as well as for a large searchlight, thus enabling safe work at night.

Including the cost of pipe line and pontoons, this entire plant cost approximately $200,000 (£41,100).

During twelve months' work in Mobile Bay the *Wahalak's* rate of advance was 4.71 feet per hour, her average for dredging per hour 574.9 cubic yards, or, in an average day of 20 hours and 17 minutes, 10,108.7 cubic yards. The total of material removed during the year was 2,921,407 cubic yards, place

SUCTION DREDGER BUILT FOR PORT USE IN THE DUTCH EAST INDIES

measurement, within theoretical cross section. This work required the use of from 1,100 to 1,500 feet of 20-inch discharge pipe and from 56 to 51 pontoons.

The following shows the principal expenses of operating this dredge:

Cost of crew and subsistence	$34,892.45	(£7,060)
Fuel	15,585.68	(3,200)
Miscellaneous and engine room	3,421.38	(703)
Repairs, renewals, etc	12,758.37	(2,620)

In addition to this the cost of operating a tow boat and launch and repairs to same, together with the cost of operating the pipe line, brought the total to $80,002.86 (£16,400), which made the field cost 2.74 cents (1.37d.) per cubic yard. Other outlay, together with office expenses, brought the total gross cost to 3.24 cents (1.625d.) per cubic yard. The material removed consisted of clay, sand and mud.

Suction Cutter Dredger Governor General Idenburg

The dredger *Governor General Idenburg* was designed and built in the works of Messrs. Werf Conrad, of Haarlem, Holland, to the order of a Dutch firm of contractors for works in the port of Macassar in the Dutch East Indies. The principal dimensions are the following: Length on waterline, 215 feet; breadth, 37 feet 6 inches; depth at sides, 21 feet 3 inches; draft loaded, 18 feet; capacity of hopper, 28,000 cubic feet; maximum working depth, 67 feet. The two main engines are of the vertical triple expansion type, each capable of developing 500 horsepower when running at 150 revolutions per minute. These engines can be coupled either to the propellers or to the two sand pumps, so that the full engine power may be used for either purpose. A third engine of the horizontal compound type, developing 200 indicated horsepower, is fitted on the top end of the suction pipe and serves to drive the cutter gear. Steam is generated in two boilers having a heating surface of 2,150 square feet each.

This dredger is intended to work both in clay and in sand, in view of which it is provided with two suction pipes, viz., one pipe suspended in a well and provided with a clay cutting arrangement, and one ordinary suction pipe suspended on the port side of the vessel. The suction and delivery connections of both pumps are so arranged that the dredger may be worked in either of the following six different ways.

1. Suction openings of one or both pumps connected to suction pipe in well. Delivery openings of one or both pumps connected to (*a*) the hopper, (*b*) a pipe connection leading to the sides of the ship for delivery into barges alongside, and (*c*) a floating pipe line.

2. Suction opening of one pump connected to suction pipe in well, delivery opening of same pump connected to suction opening of the other, delivery opening of second pump connected to floating pipe line.

3. Connections as No. 1 substituting suction pipe at side for pipe in well.

4. Connections as No. 2 substituting suction pipe at side for pipe in well.

5. Suction openings of one or both pumps connected to hopper, delivery openings of one or both pumps connected to one or two floating pipe lines.

6. Suction opening of one pump connected to hopper, delivery opening of same pump connected to suction opening of the other, delivery opening of second pump connected to floating pipe line.

The diameter of both the suction and delivery pipes is 23½ inches.

The maneuvering of the vessel is effected by means of a central winch, manipulated from a pilot house in which all handles from the central and suction pipe winches are united. This central winch takes the wire ropes of two side anchors and two spuds.

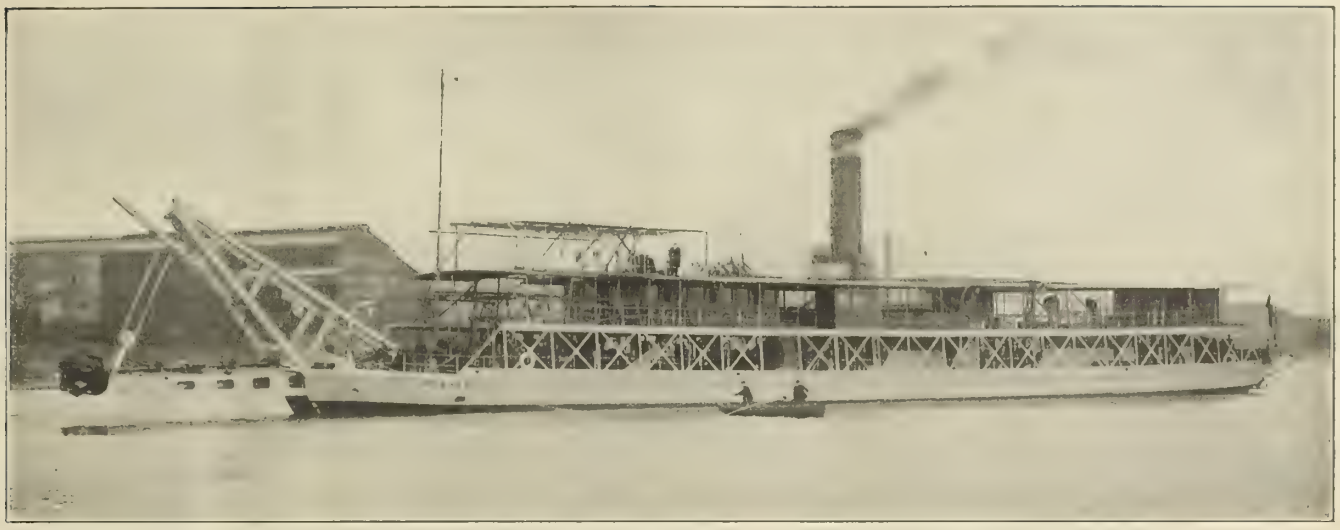


FIG. 1.—SUCTION CUTTER DREDGER OSWALD FOR INDIAN GOVERNMENT

Suction Dredgers

By the introduction in recent years of mechanical devices working in front of the suction nozzle remarkable developments have taken place in the application of suction dredging. Many different kinds of materials ranging up to the stiffest class of blue clay, chalk and rock have been attacked successfully. Previous to the introduction of these mechanical aids, suction dredgers could only be profitably employed in sand, or sand and silt, powerful water jets being employed when the sand was of a hard, compact or indurated nature, the disintegrating action of the water jets rendering the hard sand susceptible to the centrifugal force exercised by the suction pump. Water jets have still their place in suction dredging and are not at all likely to be superseded in certain classes of material for which they are specially suitable. With the construction of this suction cutter type of dredge the name of Messrs. Wm. Simons & Co., Ltd., of Renfrew, has been very closely identified.

This firm have just recently constructed and delivered under their own steam three large suction cutter dredgers, the *Oswald, Campbell* and *Lees* (see Fig. 1) for the Government of India. These dredgers are of the Simons suction reclamation type and will work in conjunction with a floating pipe line and terminal pontoon arranged for delivering dredged material over river or canal banks for land reclamation.

One of the great advantages which the cutter suction type of dredger has over the bucket ladder dredger is that the former, while capable of doing the work which formerly could only be done by the latter, is not saddled with so many parts subject to wear. The array of upper and lower tumblers, buckets, links, pins and rollers necessary in bucket ladder dredgers is subject to heavy wear and tear, and consequently much expense is incurred in keeping dredgers of the bucket type in good condition. The absence of so many wearing parts in cutter dredgers, on the other hand, naturally tends towards the reduction of maintenance charges. This feature must commend itself not only to contractors, but also to all harbor boards, government departments and other public boards who have much dredging work to do.

For dredging mud and soft clay, trailing suction hopper dredgers are indubitably the most suitable. One of the earliest dredgers of this type built by Wm. Simons & Co., Ltd., was the *Antleon*, in 1898, to the order of the New South Wales

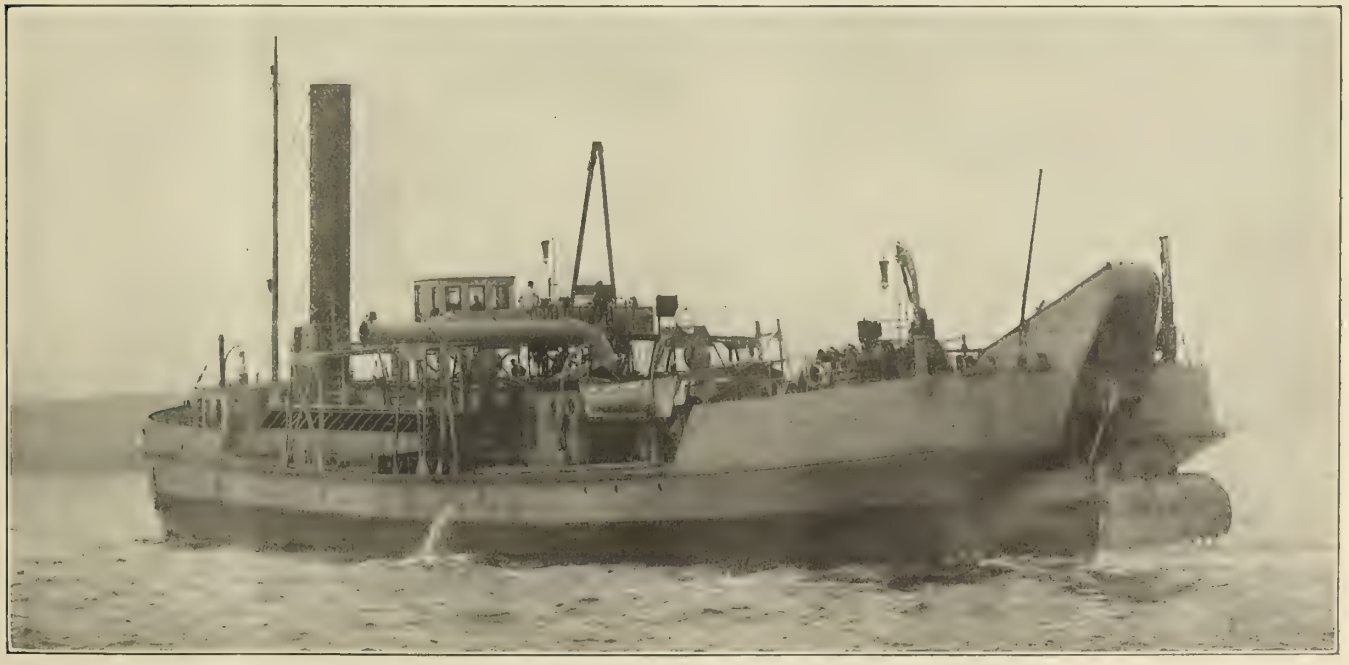


FIG. 2.—TWIN SCREW TRAILING SUCTION CUTTER HOPPER DREDGER CANTERBURY

Government. In these vessels neither anchors nor chains are used when dredging. The dredger steams slowly ahead and takes her load ready for dumping in deep water.

The latest type of dredger introduced by Messrs. Simons is the combined drag and cutter suction dredger. The suction frame is arranged to take either a drag nozzle or a rotary cutter. The drag nozzle is employed when mud or soft clay is being dredged and the cutter when hard clay or other similar material is encountered, which otherwise would not yield to the action of the dredging pump. Even with this meagre description the wide range on very different classes of material of combined drag and cutter suction dredgers will be at once apparent. The *Canterbury* (Fig. 1), constructed fully a year ago to the order of the Lyttleton Harbor Board, is the first vessel of this type. The results obtained by the *Canterbury* in her ordinary work have, according to reports received from C. I. R. Williams, Esq., H. I. C. E. Engineer to the Lyttleton Harbor Board, exceeded all expectations.

Grab Dredger Curraghgour

In our last annual dredge number mention was made of the construction of the grab dredger *Curraghgour,* built by the Dublin Dockyard Company, North Wall, Dublin. Since then this dredger has been given thorough trials, establishing the capabilities of the dredge. The hull is 146 feet long, 30 feet 6 inches beam, with a molded depth of 12 feet 6 inches. She

GRAB DREDGER DESIGNED FOR CUTTING HER OWN FLOTATION

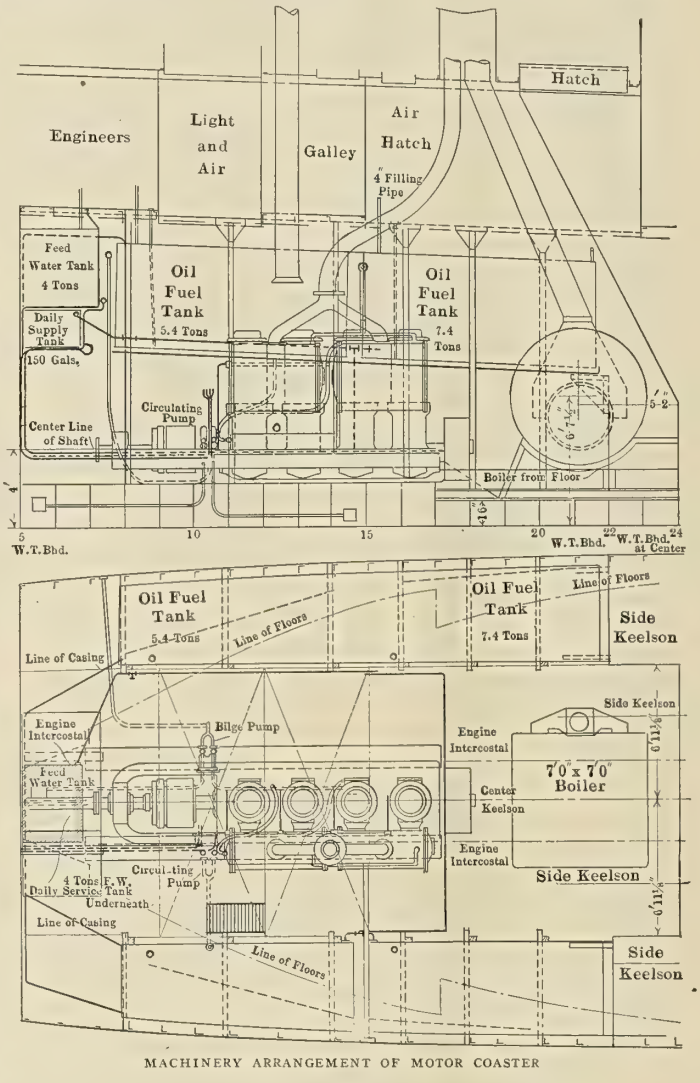
has a deadweight carrying capacity of about 520 tons of spoil, in addition to a week's supply of coal, all of which is carried on a mean draft of 11 feet. A special feature in the design of this dredge is that the forward crane has been so arranged and has sufficient outreach to allow dredging over the bow of the vessel, and consequently cutting her own flotation. The propelling machinery is fitted aft and consists of a set of compound surface condensing engines having cylinders 15 inches and 32 inches diameter by 24 inches stroke, steam being supplied by a cylindrical return tube boiler working at 120 pounds pressure. The two dredging winches for working the grabs, together with the grabs themselves, are of the most modern type of Priestman's pattern. The grab dredgers were found, on trial, easily capable of lifting the specified 160 tons per hour.

MONTHLY SHIPBUILDING REPORTS.—The Bureau of Navigation reports 135 sailing, steam and unrigged vessels of 34,078 gross tons built in the United States and officially numbered during the month of March, 1913.

British Motor Coaster Isleford

Considerable progress has been made in Britain and on the Continent during the past year in the building of high-powered Diesels for seagoing vessels, but when one comes to consider it great development has also taken place in the so-called semi-Diesel installation, or low compression residue oil motor; in fact, the latter type of engine bids fair to become a very serious opponent of the Diesel engine where powers up to at least 500 brake horsepower are concerned.

In Scotland alone there were turned out last year six motor coasters fitted with semi-Diesels of 80 brake horsepower to



MACHINERY ARRANGEMENT OF MOTOR COASTER

130 brake horsepower, while at the present moment no fewer than thirteen other vessels of this class are building in yards on the Clyde and Firth. Over 130 brake horsepower, however, neither Britain nor any other country has had experience of semi-Diesel machinery in sea service, hence the 350 brake horsepower Bolinders engined vessel *Isleford,* which ran her trials recently on the Firth of Clyde, is of the greatest interest at the moment.

The *Isleford* was constructed by the Ardrossan Shipbuilding & Dry Dock Company, Ardrossan, for Messrs. Mann, MacNeil & Co., Glasgow. She is to Lloyds highest class and will be used in the general coasting trade. Her dimensions are 149 feet between perpendiculars by 25 feet 6 inches beam by 11 feet molded depth, and generally she is very similar to the usual steam coaster of the size, having the raised poop and forecastle decks, the long cargo hold amidships and the ma-

chinery space aft. The captain and officers are arranged for aft in the poop deck casings, while forward are the usual quarters for the crew. The vessel has a deadweight carrying capacity of 480 tons in a single cargo hold, which is entered by a hatchway of no less than 58 feet in length.

It is, however, the machinery of this vessel that calls for special mention. The main engines consist of a four-cylinder two-stroke cycle set of the above-mentioned make, the cylinders being about 16½ inches by 17 inches. The power is developed at 225 revolutions per minute, but the engine, we are told, is capable of being speeded up to 235 revolutions per minute. Reversing is on the pre-ignition principle and the same as seen on the smaller Bolinder models, only in the case of this big installation we noticed a remarkably neat device fitted which automatically throws in the governing mechanism as the clutch is withdrawn, and so prevents any racing of the engine. Blow lamps are, of course, employed for heating up

The deck machinery, which consists of two powerful cargo winches, windlass, warping capstan and steering gear, is all steam-driven, steam being supplied from a 7-foot donkey boiler of the single-ended Scotch type, fitted with the Wallsend Howden patent fuel oil burning apparatus. This boiler, as will be seen from the drawings, is situated at the forward end of the engine room. There is also in the engine room a steam bilge and ballast pump, interconnected with the bilge pump on the main engines, and steam oil pressure and boiler feed pumps. In this oil-firing apparatus the fuel, which, by the way, is drawn from the main tanks, is injected into the furnace in the form of a conical spray of exceedingly fine particles by a special oil fuel pump. A small auxiliary oil heater, heated by means of a naphtha burner, is also supplied for raising steam in the boiler. Generally in these oil-fired sets we see a handle on the steam pump, but in this case there is a small independent hand pump which pumps the oil to the auxiliary

MOTOR COASTER ISLEFORD RUNNING TRIALS

prior to starting, and it may be here mentioned that only about twenty minutes is required for getting under way from cold.

The engine being of the solid injection type, and by this is meant that the fuel is pumped into the cylinder head in liquid form and so pulverized by compressed air, there is no cam shaft with its intricate gearing and no two-stage air compressor to absorb about 15 percent of the power. The circulating and fuel pumps are driven from eccentrics on the aft end of the crank shaft, while a 4-inch bilge pump is driven direct from the forward end of the crank shaft at engine speed. Compressed air, however, is used for starting up and maneuvering and the air tank, which under ordinary conditions is charged by the main engines, is arranged under the fuel tanks on the starboard side. There is a hand air compressor, however, fitted as a standby in case the air should at any time be lost when the engines are idle.

Fuel to the extent of 25 tons is carried in four tanks situated in the engine room. These tanks are all connected to a common service tank of 150 gallons capacity. On the supply from the service tank there is a large filter on which are mounted four hand pumps for charging the fuel pipes prior to starting. heater, after which it passes through a duplex discharge strainer and thence to the burners. Once there is a sufficient head of steam in the boiler this hand pump is put out of action and the fuel is drawn direct from the tanks by the steam pump and delivered to the main heater, where it is heated to the required temperature.

The contract for the machinery of the *Isleford* was, we may say, in the hands of Messrs. Douglas Primrose & Company, Glasgow, the Scottish agents for Bolinder's motors.

On Feb. 20 and 21 trials were carried out on the Firth of Clyde, when the machinery gave complete satisfaction. On the first day the vessel left Ardrossan fully loaded and proceeded to the Skelmorlie mile, where a mean speed of 9.05 knots, or half a knot over the guarantee, was attained. Later in the day maneuvering trials were held, when the reliability of the Bolinder reversing mechanism was well demonstrated. On the following day the vessel carried out a continuous run of about seven hours, in the course of which she was again taken over the measured mile. Throughout the trials it was pleasing to note the machinery ran without a hitch and gave no trouble of any kind.

Handling Freight at a Steamship Terminal

The New York Dock Company has recently installed a system of rapid freight-handling machinery for their export and import freight at the company's docks, located at the foot of Baltic street, Brooklyn, N. Y. The freight consists of the usual miscellaneous ocean-traveling freight of every description, of every size and of every shape, in boxes, barrels, crates, bales, kegs, flasks, sacks and sheet and bar metals. All this freight is handled by the machines to and from lighters, wagons, warehouse, freight house, railroad cars and delivery trucks.

The company's docks extend along the Brooklyn shore of New York Bay for about 2¼ miles, the property covering 300 acres and being entirely occupied with warehouses and railroad tracks. The freight is transported to and from the various warehouses by wagons and cars. The company has its own system of railroad tracks, which extend along the entire water front, and they use several dinkey locomotives for handling the cars. The only connection with the different railroads is by car ferries, which carry the cars back and forth to the railroads. These ferries connect with the company's tracks at the car-ferry slip, as shown on the plan view (Fig. 1), and the slip is so constructed as to provide for the rise and fall of the tide. There are 27 piers extending into the bay at which the large steamers dock for unloading and loading. The entire freight for these steamers is handled by lighters and wagons, as the railroad tracks do not run out onto the piers.

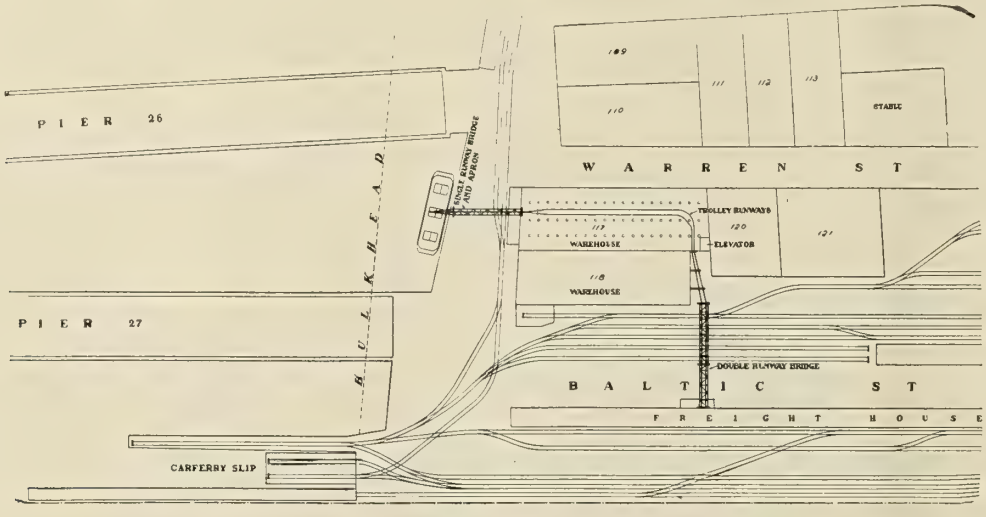


FIG. 1.—PLAN OF NEW YORK DOCK COMPANY'S PLANT AT THE CAR-FERRY SLIP

The handling machinery is used in connection with warehouse No. 117, which is used only for sorting and storing the export and import freight. It is a six-story brick building and is approximately 211 feet long by 68 feet wide. The only alteration in the building to allow for the installation of the machinery was the cutting of doors in the front and rear. The company buys its power from the Brooklyn Electric Light Company for lighting and operating the machines.

The machinery installed was the Brownhoist rapid freight-handling equipment. It consists of a single runway bridge on the wharf, a double runway bridge extending over the railroad yard and reaching the freight house, two I-beam tracks through the warehouse connecting the single and double runway bridges, and two man trolleys. The tracks on the two bridges consist of 15-inch I-beams, the same as the I-beam tracks connecting the two bridges. This gives a continuous I-beam track from the wharf, through the warehouse to the freight house, on which the man trolleys travel.

The single runway bridge extends from the warehouse door to the face of the dock, a distance of 76 feet, spanning two tracks and the wharf. It is equipped with a raisable apron, 28 feet long, which reaches out over the water. By means of a counterweight and a hand winch, this apron is raised and lowered, allowing the lighters to dock. This apron is also equipped with the I-beam track, so that the trolleys can run out over the boats with their loads. The I-beam track on the single runway bridge runs into the second story of the warehouse, and just within the door it branches into two I-beam tracks. The connection between the single track and either one of the two tracks is made by a switch which is operated from the floor by hand chains. The two tracks run to the rear of the warehouse and then turn to the right and pass by an elevator and out in the rear of warehouse 118 and connect with the two tracks on the double runway bridge. The I-beams are suspended from the ceiling in the warehouse by patent hanger bolts, and bolted together by patent joining plates. It was necessary to put a small curve in the two tracks at the point where they pass the elevator, owing to the location of the elevator, bringing the tracks closer together at this point. The double runway bridge is a stationary structural bridge, supported by two shear legs and the freight house. It is 103 feet long and spans several railroad tracks and crosses Baltic street.

Two Brownhoist electric man trolleys, capacity 2¼ tons, are used for carrying the freight along the runways. Each trolley is suspended from two 4-wheel trucks by swivel and pin connections and it rounds all curves which have a radius of 15 feet or more. The truck wheels travel on the lower flange of the I-beam tracks, two wheels on each truck being connected to travel motors. The hoisting motor is carried on the front of the trolley and is geared to two hoisting drums. There are two hoisting ropes, one on each drum, from which a carrying frame is suspended on a sheave at each end. The limiting height of hoist is 30 feet. The trolley has a hoisting speed of 50 feet per minute, with full load, and 120 feet per minute with no load, and has a traveling speed of 450 feet per minute with full load and 550 feet per minute with no load. Each trolley is equipped with a hand traveling brake and with an automatic safety mechanical brake, as well as a solenoid

FIG. 2.—FREIGHT HOUSE END OF BROWNHOIST RAPID FREIGHT-HANDLING EQUIPMENT

brake for hoisting. The mechanical friction brake operates only on the downward direction of the load, and the solenoid brake operates when the hoist motor is not being driven. The load can be held at any desired height by means of these two hoisting brakes. All switches and controllers and the hand travel-brake lever are located in the cab just in front of the operator's seat. The current, 220 volts, direct current, is obtained through spring collectors with bronze collector wheels, which run on a copper trolley wire strung along the I-beam tracks. The trolleys travel in both directions.

For carrying the freight the company uses twelve special 2-ton Brownhoist trucks. The truck is equipped with ballbearing wheels, two 10-inch wheels at one end and two 2-wheel swivel casters at the other end, and with full load it is easily pushed around on the floors and in and out of freight cars. Each truck is 8½ feet long by 3½ feet wide, overall dimensions. At each end of the truck there is a structural frame to hold the load, and on top of each end frame there is a hook plate, which engages the hooks on the carrying frame of the trolley. For carrying sling loads of miscellaneous freight the carrying frame is equipped with a swiveled hook in the middle.

The company receives its freight by ocean steamers from foreign countries, by lighters and barges from points along

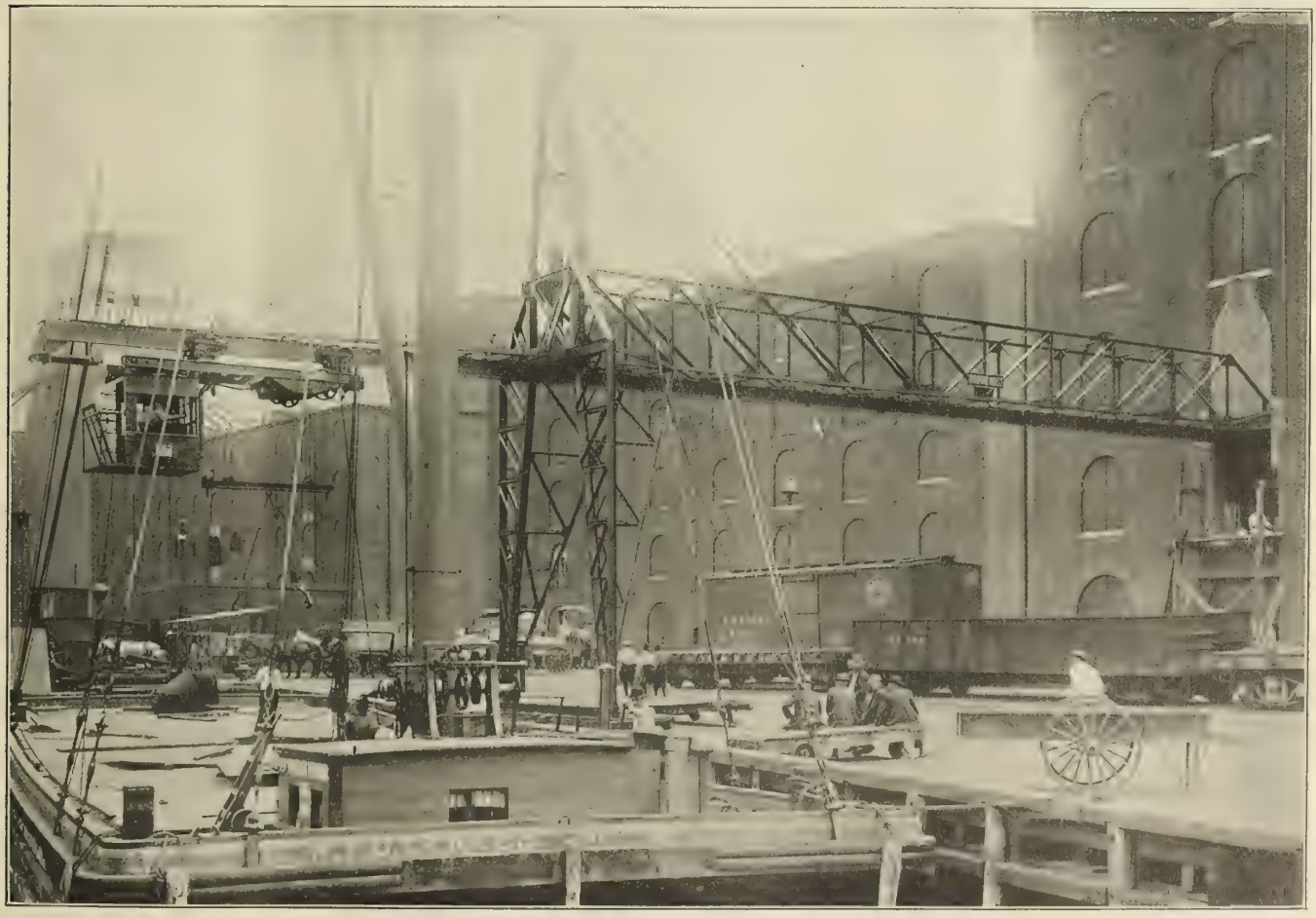


FIG. 3.—WHARF END OF FREIGHT-HANDLING EQUIPMENT, SHOWING TROLLEY HOISTING PLATES FROM LIGHTER

the river and along the coast, by railroad cars from different parts of the country, and by delivery trucks from the city. Freight is also shipped out by these various means. The ocean steamers dock at the various piers and unload their cargo onto the piers and lighters. On the piers the freight is carried by hand trucks to the various storage places, and then handled by wagons from the storage places to the various warehouses. The lighters are unloaded by the trolleys, which carry the freight to the freight house or into warehouse 117 if for reshipment by water. The ocean steamers are also loaded by the lighters and wagons with freight coming from the warehouse, freight house and cars.

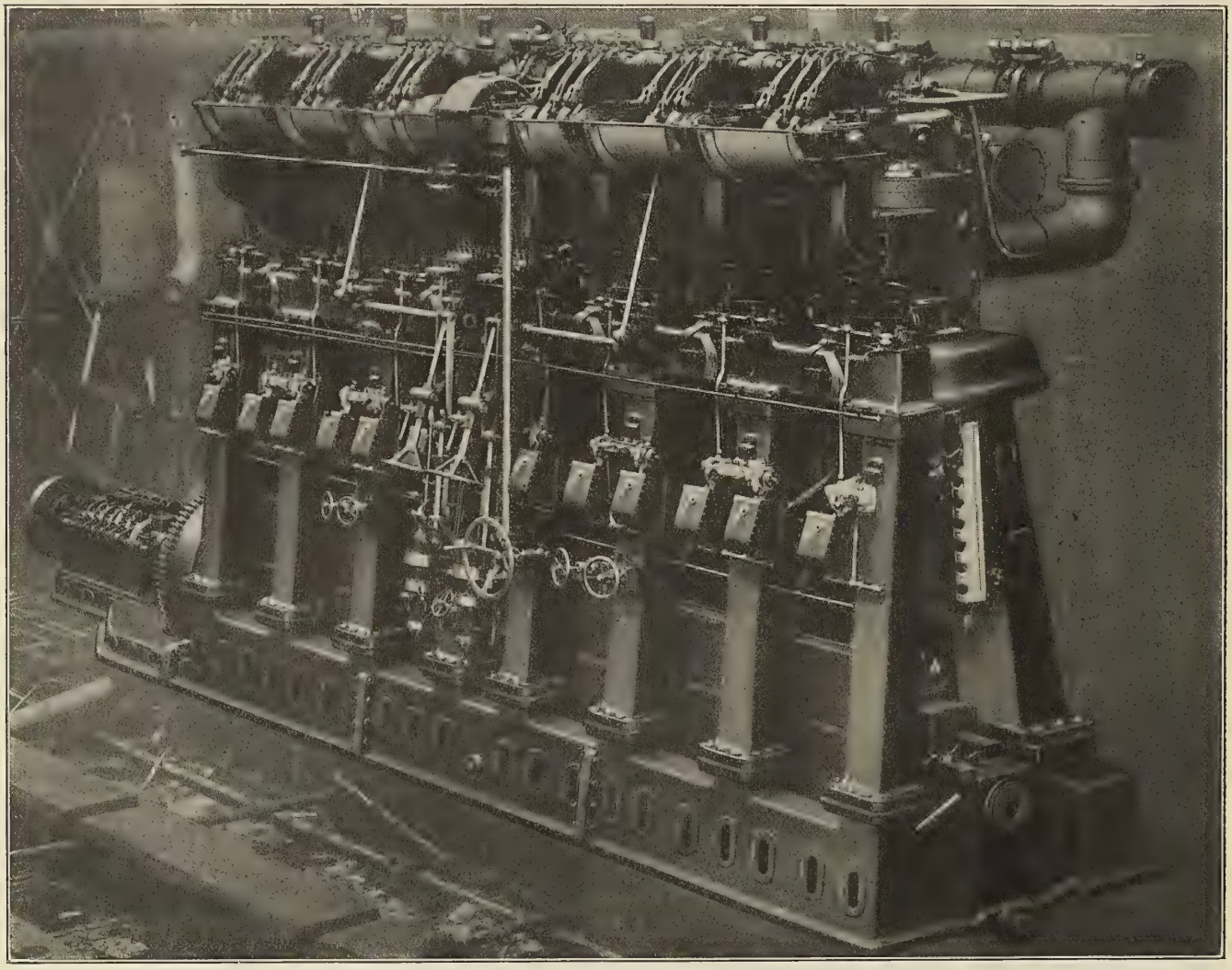


FIG. 1.—ONE OF THE HAGEN'S MAIN ENGINES ERECTED IN THE BUILDERS' SHOPS

Freight for export coming in by cars in carload shipments is unloaded directly onto the lighters or wagons to be taken to the steamer, but if the steamer is not in, the freight is taken into warehouse 117, where it is held until the steamer's arrival. Freight coming in by cars in less than carload shipments is unloaded at the freight house, sorted and delivered to the local trucks or to other cars, or to warehouse 117 if for reshipment by boat. Freight delivered to the freight house by local shippers is sorted and loaded into cars or taken to the warehouse to await the arrival of the boat.

The trolleys do the unloading and loading from and to the lighters, wagons, cars and gondola cars, either with the trucks or by sling loads depending upon the character of the freight. In warehouse 117 the trolleys work in conjunction with the elevator and with a chute which runs from the top floor down to the second floor. The trolley carries a truck loaded with freight which is to be stored for several days into the warehouse and deposits it at the door of the elevator. The truck is pushed onto the elevator and carried to one of the four floors above, where it is held until the steamer arrives. When the steamer arrives the freight is loaded onto trucks and carried down by the elevator to the trolleys, which take it out to the lighter or to the wagon, as the case may be. If the freight is not fragile and is of small size it is sent down the chute to the second floor and there loaded onto the trucks. This latter operation saves the time of coming down the elevator. When each trolley deposits a load it picks up another one without losing time for loading or unloading. As yet the plant is not running to full capacity, but so far the equipment has replaced 12 men in the warehouse and freight house.

The trolleys handle all the freight as fast as it can be delivered to them, which enables the company to make prompt shipments, whereas heretofore when hand labor was used many shipments suffered considerable delays. This means a saving in demurrage charges and is giving the company a reputation for prompt shipments. The equipment has eliminated the congestion of wagons on the dock. Furthermore, in the handling of the freight to and from the cars the handling charges have been cut in half.

J. W. Galbreath is the consulting engineer for the New York Dock Company, and F. R. Lackey is general manager of the New York Dock Railway. The handling equipment was built and installed by the Brown Hoisting Machinery Company, of Cleveland, Ohio.

German Diesel Engined Tank Ship Hagen

The rapid increase in the consumption of mineral oil of all classes has had in the last few years the result of a very strong demand for tank ship tonnage. This at the present time represents, with its resulting new construction, the most active branch of shipbuilding all over the world.

The new ships, numbering over 100, partly of extraordinary size, surpass the average of previous years almost ten times. Of this number the German-American Petroleum Company alone has ordered about one quarter. Of the 16 tankers at present building in Germany for their account, 3 are of special interest as being engined by the Germania shipyard with oil engines.* The development of the Diesel engine to large units, well suited for the main engines of ships, made its application particularly desirable for tank ships, as in them the full economy of the Diesel engine could be realized with the lowest fuel consumption and first cost. A further advantage is the absence of any open flame in the Diesel engine and consequently a decreased danger of explosion.

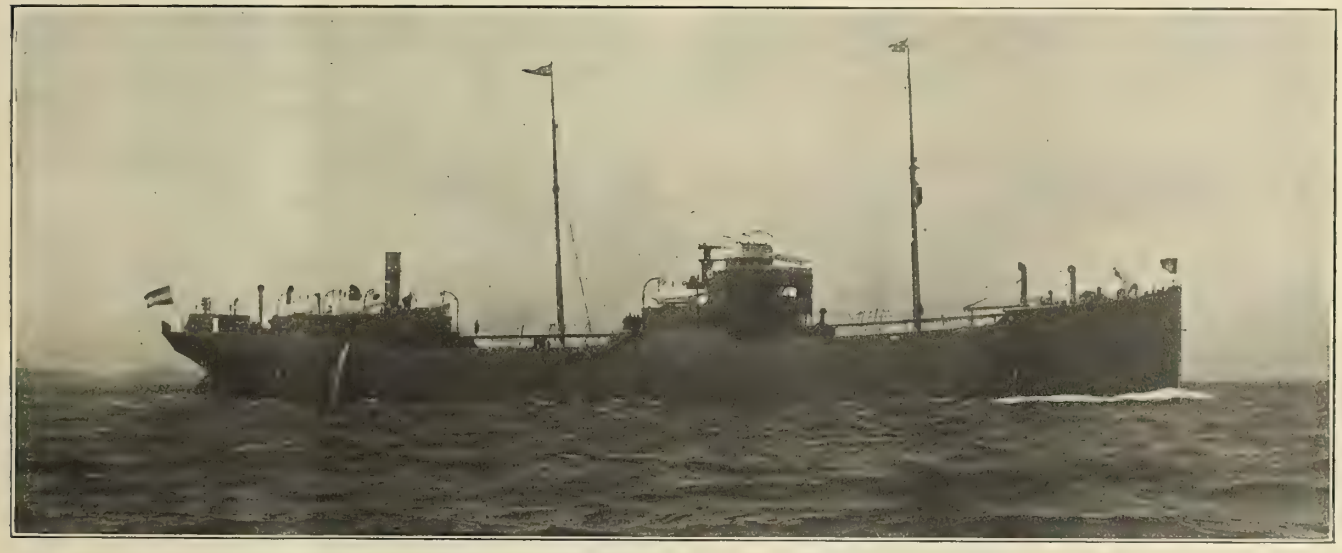


FIG. 2.—OIL MOTOR TANK SHIP HAGEN, BUILT AND ENGINED BY FRIED. KRUPP A. G. GERMANIA SHIPYARD

The oil motor tank ship *Hagen,* built and engined by Fried. Krupp A. G. Germania shipyard, and illustrated herewith, was launched Nov. 28, 1912, as the first of the oil engine tankers ordered by the German-American Petroleum Company from the Germania shipyard. It is the first German seagoing vessel with oil engines of a German make.

The ship is built after the transverse frame system for the class of the English as well as of the Germanic Lloyd Society under special survey of both companies. The main dimensions are: Length between perpendiculars, 400 feet; beam, molded, 53 feet; depth at side to upper deck, 32 feet 4 inches; deadweight with summer freeboard, 8,200 tons; engine, brake horsepower at 140 revolutions per minute, 3,000; speed under full load, 11 knots.

The *Hagen* is a twin-screw ship with machinery spaces aft. The arrangement of placing the machinery aft is not unusual for tank ships, as this avoids an interruption of the longitudinal centerline bulkhead and also avoids the oil-tight shaft alley through the after oil tanks.

The ship is fitted with poop, bridge house and forecastle above the main or upper deck. The hold, extending from the keel to the 'tween deck, is divided into seven equal tanks and bounded fore and aft by the required cofferdams. A third cofferdam and the pump room further arrange the tanks in three groups, giving thereby the chance of handling different kinds of oil without danger of mixture by leaky bulkheads. Each of the seven tanks is divided in halves by an oil-tight longitudinal centerline bulkhead, which extends from the keel to the upper deck. Whenever the cargo is of the same grade of oil also the third cofferdam can be filled with it. Between the upper and 'tween decks on each side of the centerline bulkhead are tanks extending the entire length of the lower tanks, but only about one-half their width. These expansion tanks allow the oil to rise in its level and also with sufficient height prevent a swashing over of the cargo under transverse rolling of the ship. The small tanks outside of the expansion trunks above the 'tween deck are the so-called summer tanks, which have to be employed as cargo tanks with oils of low specific gravity, to realize the full carrying capacity of the ship.

Every main hatch has a steel cover which is securely bolted down, and removed only upon occasions of large repairs or when the hold has to be used for general cargo. A smaller hatch or manhole is in the large cover, and in its cover are the connections for the filling pipes or hose. The summer tanks have only small hatches. The gases that will evolve from the cargo are carried off by pipes from the hatches to the masts and carried well up. A valve which automatically opens under a certain excess pressure, as well as under a certain vacuum, closes every pipe line at the mast and prevents too large an evaporation from the cargo. The cargo is discharged by two steam piston pumps, each of 250 tons capacity per hour, either over the side or over the stern of the vessel. Each tank can be filled or discharged separately and independently. All pumps are arranged in the pump room, and the oil-handling pumps are with all their pipe systems completely separated from the water-handling pipe lines, and the latter are also kept entirely clear from the oil tanks, so that the danger of oil leakage is reduced to the very minimum.

The gases that remain in the tanks after the discharge of the cargo are removed by a powerful fan, using as its inlet piping the pipe lines for the oil discharge. Steam pipes extend nearly down to the bottom of each tank for the purpose

* The shops of Fried. Krupp A. G. have furnished or have on order 69 marine oil engines totaling about 55,855 brake horsepower, aside from 146 stationary oil engines of about 26,634 brake horsepower.

of steaming the tanks and of extinquishing a possible fire. All pipe lines, as well as the two wire electric conductors, are arranged on the upper deck, partly on iron brackets, partly under the fore and aft flying bridge between the deckhouses. This flying bridge is for the regular communication by the crew, as the upper deck with its oil hatches shall be used only when repairs have to be made there, thus securing the greatest safety against possible fires. These arrangements reduce even the dangers that might arise from a cargo of gasoline (petrol) or benzine to the very minimum.

The oil tanks serve as tanks for water ballest, and in addition two peak tanks and a large tank in the fore hold serve as tanks for trimming the ship. The tanks for water ballast

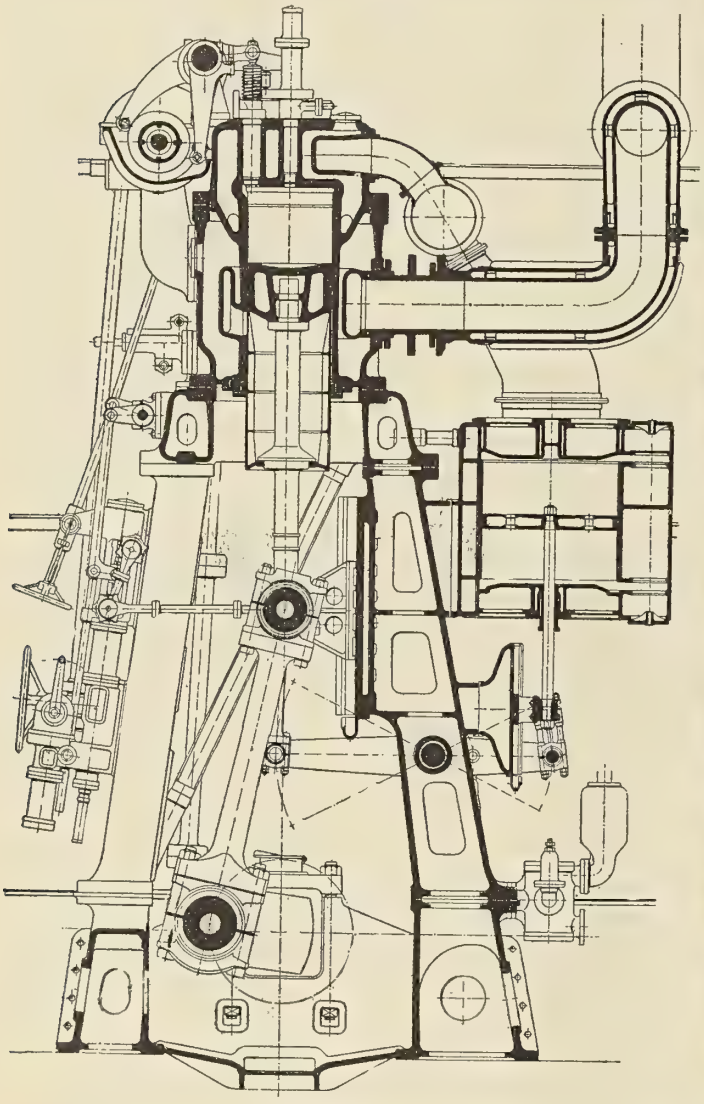


FIG. 3.—CROSS-SECTION OF MAIN ENGINE

are discharged by a steam ballast pump of 100 tons per hour capacity. It is located forward.

The ship has a double bottom aft under the engines which serves partly for storing the feedwater for the donkey boiler and partly for ballast purposes. Arrangements have been made also to carry fuel oil in the inner bottom, in case an extra large amount of fuel is necessary for unusually long voyages. For the trips between Europe and America, for which the ship is mainly built, the normal bunkers of 500 tons capacity are sufficient. These bunkers are arranged around the engine room and hatch, partly in the hold, partly on the 'tween deck. Reserve bunker space is furnished by the after cofferdam. Two small day tanks are arranged in which the oil can settle and free itself from water and sediment. The accommodations for the crew are as usually provided in tank ships. As the number of firemen is greatly reduced, it was possible to fit under the forecastle a carpenter shop. The engineer force, with the exception of the donkeyman, are quartered under the poop. Compared with a steamer of equal type and size, which needs about 25 men in the engineer department, the *Hagen* needs only 4 engineers, 3 assistant engineers, 2 helpers and 3 oilers, or in all only 12 men.

In outside appearance the *Hagen* does not differ greatly from a steamer, as a smokestack of normal size has been fitted, which includes the exhaust pipes and the smokestack for the

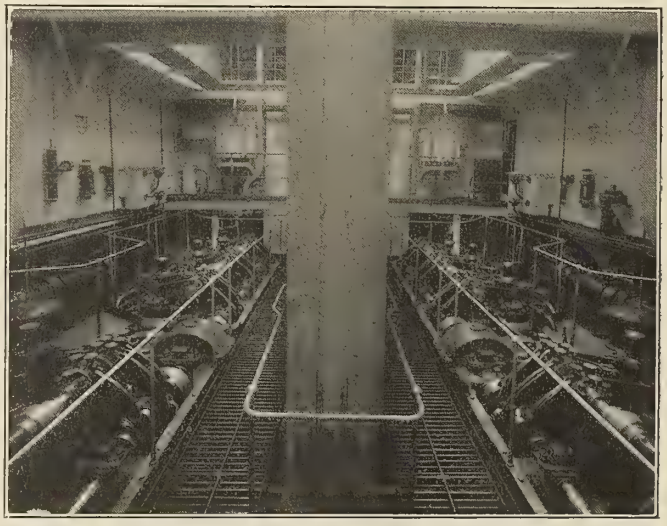


FIG. 4.—UPPER PLATFORM IN ENGINE ROOM

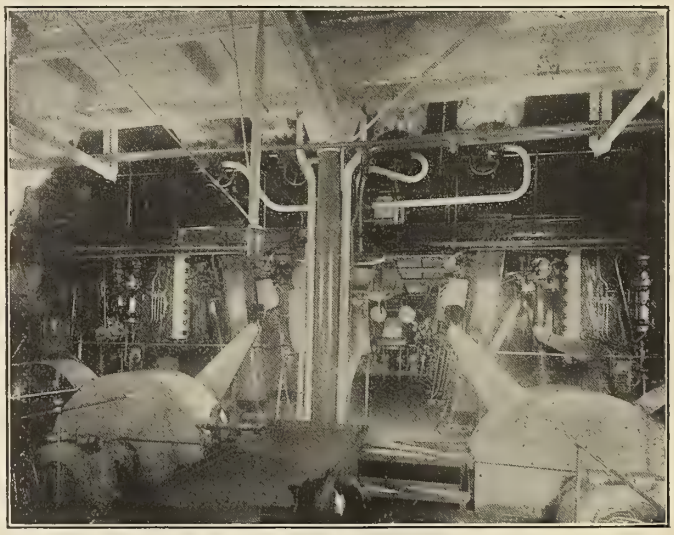


FIG. 5.—LOWER PLATFORM IN ENGINE ROOM

donkey boiler. Two light, tall masts of welded pipe serve for signal purposes and for supporting the antennæ of the wireless telegraph installation, with which all recent ships of the German-American Petroleum Company have been fitted. Four derricks are fitted, supported by separate columns, two for service at the forward cargo hatch and two at the after hatches for stores, provisions, etc.

Of special interest on an oil-engined ship are the auxiliaries. On the *Hagen* steam is provided for service in port for nearly all auxiliaries by an oil-fired donkey boiler of the two-furnace Scotch type. Where open fires are prohibited on the petroleum docks, steam is carried to the auxiliaries from shore. The anchor windlass, docking winches, oil pumps and forward

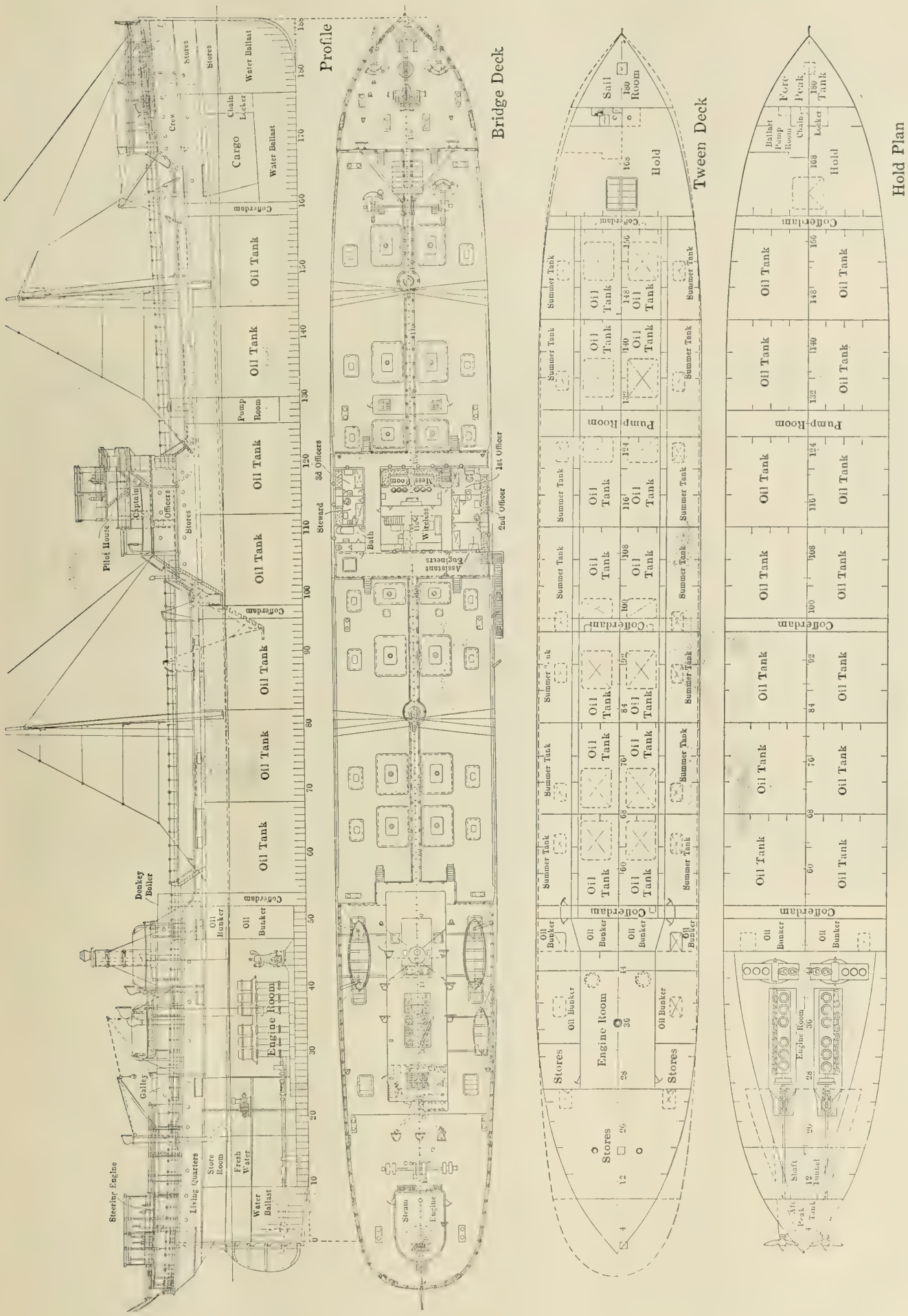


FIG. 6.—PROFILE AND DECK PLANS OF THE HAGEN

ballast pump, which are not used at sea, are therefore all fitted for steam drive. The steering engine is driven at sea by compressed air. But in docking and port service, where the consumption of compressed air is large, due to frequent reversing, it can also be driven by steam to save compressed air. It is placed in a house on the poop, acts directly by a pinion upon the loose quadrant and is actuated by a telemotor from the bridge.

Electric current for light and power purposes is furnished in port by a direct-connected steam generating set; at sea current is furnished by a set driven by a two-cycle hot bulb oil engine; the two direct-current dynamos each furnish 23 kilowatts at 110 volts.

The most important pumps are: Two steam pumps for cargo of 250 tons per hour capacity each in the pump room; one steam pump for water ballast of 100 tons per hour capacity in the forward cargo hold; one steam pump for bilge and ballast pumping of 100 tons per hour capacity in the engine room; one steam pump for filling oil bunkers of 100 tons per hour capacity in the engine room; two electrically driven centrifugal pumps for bilge and ballast pumping, deck washing, etc., one of 30 tons and one of 80 tons per hour capacity; one electrically driven piston pump for filling the day tanks with bunker oil of 20 tons per hour capacity.

At sea steam is not available and the heating of the ship is therefore done by hot water, which at sea is heated by the exhaust gases of the main engine and kept in circulation by a small centrifugal pump. If the main engines are not running the water is heated by steam. Also the steam tables in the pantry are heated from the hot water plant. Hot water for bathing and dishwashing can quickly be furnished from a bypass on the discharge pipe of the cooling water of the cylinders. In port the water for bath, showers and dishwash sinks is heated by steam fixtures. Cooking at sea is done on a coal range, but at the petroleum docks by steam, as there no open fires are allowed.

The conditions under which the ship has to work seem to make the installation of a donkey boiler the best solution of the question of auxiliaries.

The two main propelling oil engines of the Diesel type work on the single-acting two-cycle system. According to the contract each engine should furnish 1,150 brake horsepower at 140 revolutions per minute, but on the testing floor each engine developed 1,500 brake horsepower at 140 revolutions per minute. They resemble in their appearance regular marine steam engines. Every engine has six working cylinders and two scavenging pumps, which are driven by rocking levers from the crossheads of the two center working cylinders. By this arrangement the engine halves, consisting of three working cylinders and one scavenging pump each, are made completely independent from each other and can be so operated. This also gives a chance for a reduction of speed for handling purposes and of safety against collisions. The number of revolutions per minute can without difficulty be reduced to 28, or about one-fifth of the normal number of revolutions. Each rocking lever of the scavenging pumps serves also for driving two pumps. Of these four pumps two are for supplying cooling water to the cylinders, the cylinder covers and the exhaust pipes up to the mufflers, the third is for cooling the pistons, while the fourth serves as a bilge and sanitary pump.

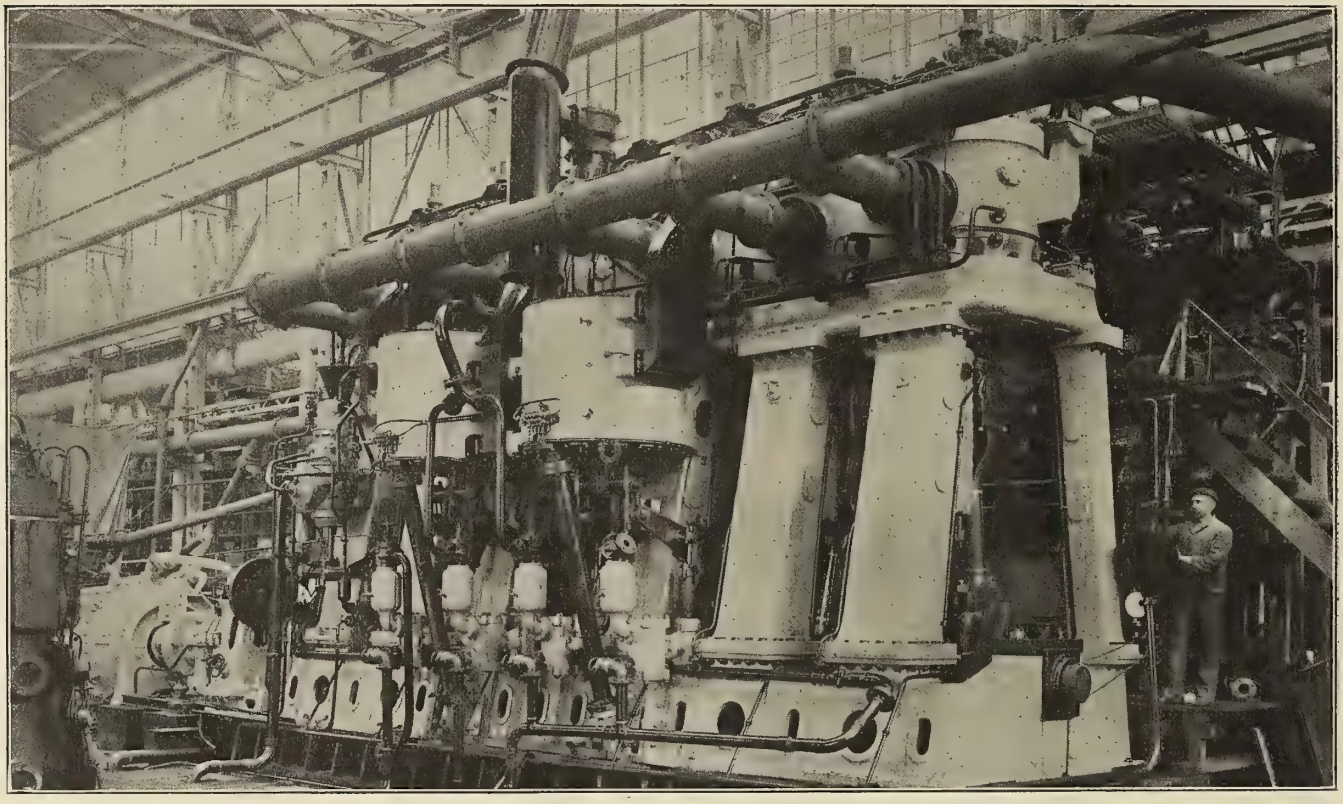


FIG. 7.—REAR VIEW OF ONE OF HAGEN'S ENGINES, SHOWING PUMPS

The crosshead of the after working cylinder also drives by rocking levers a two-stage air compressor, which furnishes the compressed air for the steering and auxiliary engines. These levers also drive one pump for supplying lubricating oil and one for furnishing fuel oil.

The engine bedplates are of cast iron, each in three parts, with oil-tight wells to catch the drip from the engines. The main bearings are of the construction usually found in merchant vessels with wrought steel caps and cast iron boxes lined with white metal. The crank shafts are each of two interchangeable parts with three cranks, so that one-half crankshaft as a spare is sufficient and fits either the forward or after half. Upon the bedplate are mounted cast iron columns which carry the water-cooled crosshead guides and above the cyl-

inder base. Good accessibility to the moving parts is secured by this arrangement of the columns.

The working cylinders are composed of the outer shell of cast iron cast in one piece with cleaning holes and of the inner working barrel, also of cast iron, which is cast together with the cylinder cover. The exhaust pipe is carried through the outer shell by a stuffing box. This arrangement allows a very convenient cleaning from deposit or sediment of the cooling water for the cylinder barrel, as well as the cylinder cover.

The pistons are of cast iron and composed of an upper water-cooled part, which contains the snap piston rings and a guide barrel, which covers the exhaust ports. To prevent still more surely any escape of the exhaust gases into the engine room, every guide barrel is fitted with a special stuffing box.

The cooling water for the piston is carried by jointed pipes to the crosshead and from this through the hollow piston rod to the piston. A pipe inside of the bore of the piston rod furnishes separate inlet and outlet passages for the water. The piston rods are in two parts to allow a removal of the pistons downward without having to remove the crossheads and the connecting rods.

Cylinder lubrication is furnished by special pressure oil pumps which are supported from the cylinder base. Lubrication of the moving parts is from drip oilers, which deliver into suitable cups of the parts. As an extra precaution hand oiling is provided for which allows in case of necessity the concentration of large amounts of oil upon certain parts. The main bearings and those of the valve gear shaft are fitted with large oil reservoirs, which feed their contents by wicks to the surfaces. All escaping oil is collected in the crank pits, from which it is drawn off by an oil pump and delivered to the filtering tanks.

The fuel oil is delivered to the engines from an elevated tank, the oil level of which is held always at the same point, thereby furnishing oil to the fuel pumps, always under constant pressure. A special pump delivers the oil to this elevated tank from a measuring tank in the engine room. This latter is arranged so low that the oil flows to it by gravity from the bunkers. Only when the oil has to be taken from the double bottom does it need the service of an electrically driven piston pump of about 20 tons per hour capacity.

The valve gear of each cylinder consists of two scavenging air valves, one fuel needle and a ring of exhaust slots, opened and shut by the piston. Including the compressed air starting valve, every cylinder cover therefore carries four valves. A horizontal valve shaft which extends the entire length of the engine drives all valves with cams, rollers and bell crank levers, which latter are mounted on two reverse shafts. The valve shaft can be shifted longitudinally and carries an ahead and backing cam for each valve separately. The valve shaft is driven by heloidical gears from a vertical shaft, which also serves for the operation of the fuel pumps. These latter can be adjusted by hand to suit any desired number of revolutions. On the upper end of the vertical shaft is a centrifugal governor, which prevents an excessive number of revolutions under pitching of the ship or in case of the breakdown of the shaft.

For reversing the reverse shafts are usually shifted by compressed air, or in emergency by hand, so that the rollers are off the cams; then the valve shaft is shifted by a hand wheel and worm gear far enough until the backing levers can bear. The reverse shaft has three main positions, viz.:

1. Full ahead, when the fuel needles and the scavenging valves work, but the starting valves do not work.

2. Stop, when the fuel needles and starting valves are not working.

3. Starting, when the fuel needles do not work, but with the starting valves in operation.

The mechanism for the shifting of the cam shaft is completely separated from the arrangements for starting and stopping the engine, as well as for the change from starting air to fuel oil. By interlocking stops the possibility of a wrong operation is entirely excluded. All of the handling and reversing gear is clearly arranged and has proved itself quite reliable.

To make sure of always having the necessary compressed air for starting, reversing and injection of fuel in the required quantity, two independent oil engine compressors are provided, each of which can furnish the required compressed air for both main engines under normal operation. Should by accident all main and auxiliary compressed air reservoirs be empty, then they can be filled by a small three-stage compressor which is attached to the oil engine of one of the generating sets. An absolute certainty of air supply is thereby secured.

The oil engines of the main compressors are single-acting three-cylinder four-cycle engines, each of 275 brake horsepower at 300 revolutions per minute, and are very similar to the reliable stationary Germania type. On account of the high number of revolutions, forced lubrication for all moving parts is provided and therefore a closed crank case is fitted, which has large covers, however, to allow full access to the parts. No crossheads are fitted, the connecting rods take hold of the wrist pins within the trunk pistons. The pistons are water cooled and the water is led to them by telescopic pipes in the manner patented by the Germania shipyard. The exhaust gases are used for heating the compressed air for the steering engine.

A two-cylinder three-stage air compressor is connected directly to each engine and liberally proportioned intercoolers provide for the necessary cooling before entering the next stage. The compressor is built for 1,100 pounds per square inch maximum pressure, but usually a much lower pressure is sufficient for normal operation. After leaving the compressor the air is cooled again and stored in the injection reservoirs of the main and compressor engines and in the large steel pressure tanks for the starting air.

The weight of the entire machinery plant of the ship, including the propelling engines with shafting and propellers, all auxiliaries and generating sets, the donkey boiler and its feed water amounts to about 580 tons. The fuel consumption of the main engines is 180 grammes per brake horsepower hour or 0.4 pound. On trial, in spite of the stormy weather, the vessel attained a speed of about 12½ knots, or about 1½ knots above contract speed.

In the design of the engines the greatest importance was placed upon absolute reliability, even under the severest sea duty, and further upon low fuel consumption, easy accessibility to and removal of parts and quiet running. The realization of weight reduction was less considered. In cases where the smallest possible weight with sufficient reliability is the first question and fuel economy comes later, there the weight of oil engines can, of course, be most materially reduced.

The success which the *Hagen* has realized on the trials proves again that the Diesel engine is to-day fully prepared to fulfill all expectations, even of the largest ships, as regards reliability and handiness. In economy it is quite superior to other machinery types. A further advance on the road, of using it even for the largest seagoing vessels, is furnished by the third tank ship, for which the German-American Petroleum Company has given an order to the Germania shipyard. With its capacity of 15,000 tons and its 4,000 brake horsepower in the two main engines it will be the largest oil engine ship so far constructed.

To the Germania shipyard is due the credit of having materially contributed to the rapid development of the oil engine, formerly with stationary and submarine engines, and now with these three tank ships.

McAndrew's Floating School

BY CAPT. C. A. McALLISTER*

"To prevent too great a radiation of heat from the cylinders they are lagged with blocks of a non-conductor, such as magnesia or asbestos, 1½ to 2 inches thick, held in place either by wood staving or planished sheet iron. This accomplishes two purposes: one of making the engine more efficient by preventing the loss of heat, and the other of keeping the engine room from becoming too hot for comfort.

"O'Rourke, do you know what a non-conductor is?"

"It must be a conductor that don't belong to the union," replied the Irishman.

"Oh! I'm not talking about street cars," testily replied McAndrew. "There are certain substances which transmit heat very readily, and they are termed 'conductors'; others which transmit heat very slowly are known as 'non-conductors.' It is often said that man cannot improve upon nature, and this is verified by the fact that hair-felt, made principally of cow hair or horse hair, is about the best non-conductor we can use. Hair-felt will burn or scorch if placed on surfaces which are too hot, such as the cylinders of an engine using high-pressure steam, hence combinations of asbestos and magnesia make the best non-conductors for that purpose.

"The next parts of a marine engine to be considered are the pistons and piston rods. The pistons are made either of cast iron or cast steel; sometimes for lightness, as in the case of those used in torpedo boat engines, they are made of wrought steel. If they are made flat and of box section, that is, with double walls, the material used is cast iron. However, the majority of pistons are cast solid of conical section to provide the necessary strength, and in this shape are almost invariably of cast steel. In first-class work they should be machined all over, so as to reduce the clearance spaces as much as possible. It is necessary, no matter what the type of piston used, to provide some means of preventing the steam from leaking past the piston. This is accomplished by rings fitted in grooves in the rim of the piston, which either from their natural elasticity or from being forced outward by springs of various forms, keep tight against the wall of the cylinder and prevent the leakage of steam. These rings are always made of cast iron, as no other metal will suffice. Great care is usually taken to prevent the steel pistons from wearing against the sides of the cylinders, as steel on iron is a bad combination where the surfaces are not thoroughly lubricated.

"The piston rods, which transmit the motion of the pistons to the crossheads, are simply cylindrical columns, securely fastened to the pistons at the top and the crossheads at the bottom, by means of fitting into tapered holes, which take up the thrust in one direction and nuts which prevent movement in the other direction. Piston rods are almost invariably made of wrought steel, and to save weight are sometimes made hollow. Now I think I heard one of you fellows say, sometime ago, that a hollow piston rod is stronger than a solid one, or was it a hollow shaft you were talking about? Anyhow, you want to forget that, as I find too many people get that foolishness in their minds. A hollow rod or a hollow shaft is stronger than a solid one of the same weight, that is of the same amount of metal used, but you can see that if only the same amount of metal is used the solid rod or shaft will be of a smaller diameter. So hereafter you can say, for example, that a 6-inch hollow rod with a 3-inch hole through it is not as strong as a 6-inch solid rod, but that it is stronger than a 5¼-inch solid rod which contains the same amount of metal. Even then it is only stronger when the rod is being pressed down or in compression, as it is called; when it is being pulled, or is in tension, it would be of the same strength, whether hollow or solid, as there would be the same sectional amount of metal to transmit the pull."

"Why don't they make piston rods square instead of round?" inquired the studious Nelson.

"I'm glad you spoke of that," replied the instructor. "So far as actually transmitting the work is concerned I suppose a square rod would do as well as a round rod, but the rod must pass through the bottom of the cylinder so as not to allow the steam to escape. It would be very difficult indeed to build a stuffing-box around a square rod and keep it tight, whereas with a round rod it is comparatively simple. Another reason is that it is much cheaper to machine a round rod than it is a square one. In passing it will be well to consider the manner in which steam is prevented from leaking out of the cylinders around the piston rods and valve stems. In the olden days when the steam pressures and consequent temperatures were low, it was quite an easy matter to keep rods tight by a simple stuffing-box with an adjustable gland, packed with hemp or other form of soft packing. Nowadays the steam pressures and temperatures are so high that they would soon burn or blow out hemp packing, and the result is that metallic packing has to be used. This has been a fertile field for the inventor, with the result that almost every day a chief engineer, when in port, will be met by a man with a new kind of packing, guaranteed to be better than any other kind ever made and capable of saving at least 10 percent in the coal bills. Metallic packing usually consists of rings of cast iron, white metal or composition, held against the rod by the compression of springs of ingenious forms. The best of them is the one that keeps the rod the tightest with the least amount of friction."

"What kind is that?" said O'Rourke.

"You can search me," replied McAndrew. "Now, having described the principal features of cylinders, we must, in regular order, find what they stand on, or what it is that supports them, as you all know that the cylinders must be held in place as rigidly as possible.

"What name is given to these supports, O'Rourke?"

"'Colyums,' sir!" replied the one addressed.

"Oh! you are learning fast," said the instructor, "nearly all old-timers refer to them as 'col-yums' instead of 'col-umns,' as the word should properly be pronounced.

"Columns are made of numerous designs—of cast iron, cast steel and wrought steel. Some engines are supported on cast iron box-section columns at front and back, but I think the majority of marine engines have cast iron inverted Y-columns at the back and cylindrical wrought steel columns at the front, as shown in Fig. 6, where sections are shown also. In nearly all merchant vessels' engines the condenser is built in the engine frame and forms a part of the support for the cylinders. Short columns, to which the guides are attached, are bolted to the top of the condenser."

"I thought guides were men who show 'rubes' around the city; how do they get in on this engine game?" inquired the 'butter-in' of the class.

"On a marine engine," replied McAndrew, "the guides show the crosshead slippers how to walk the straight and narrow

* Engineer-in-Chief, United States Revenue Cutter Service.

path; if they permitted them to roam around very much there would be trouble. In that respect they differ from the average two-legged guide such as you have met on shore.

"The guides shown in the above sketch attached to the Y-columns are the kind used most extensively for marine work. When the engine is backing, the pressure on the guides is in the direction opposite from that when it is going ahead, so this pressure is overcome by what are known as 'backing guides,' which are shown in section C-D. The space back of the 'go-ahead' guide is usually fitted for water circulation, whereby the cold sea water flowing through removes the heat caused by the friction on the rubbing surfaces. Marine engines back so little of the time that it is seldom necessary to fit the 'backing guides' for water circulation.

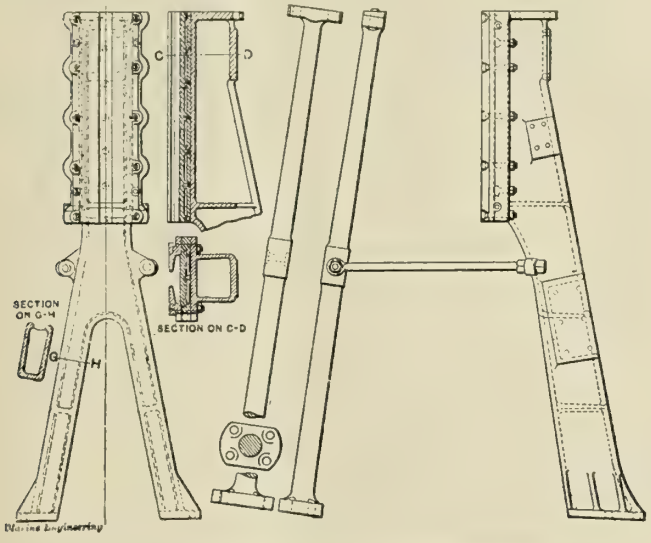


FIG. 6.—INVERTED Y AND CYLINDRICAL COLUMNS

"On our way down the engine we next come to the connecting rod, by means of which the up-and-down or reciprocating motion is transformed into a circular or rotary motion by means of the crank. Perhaps Schmidt can tell us the German name for connecting rod."

"Sure!" said Schmidt. "In the old country they call it the 'verbindungstücken.'"

"Gee!" chimed in O'Rourke, "that's about as long as the rod itself!"

"Yes, the word is rather long, and it means, literally, a binding stick, because it binds or connects the crosshead to the crankpin. These rods are almost invariably forged of mild open-hearth steel. Fig. 7 illustrates the type in most general use.

"The upper end, as you will see, is forked to span the crosshead, each side of the fork being fitted with a bearing and the necessary connections to work on the crosshead pin. Solid brass or bronze is used for the bearing metal, as the pressure is too great to permit of the use of soft, anti-friction metal in the bearings. The lower end of the connecting rod is provided with brasses and a cap or binder, all secured by bolts to the T-shaped end of the connecting rod. These brasses are always fitted with 'Babbitt' or other anti-friction metal to reduce the rubbing friction on the crankpin. The white metal surfaces are scored with oil grooves to allow a proper distribution of the lubricating oil. Bearings, such as crosshead and crankpin brasses, necessarily are subject to wear, and consequently must be provided with means of taking up the lost motion. To that end there are spaces between the top and bottom brasses in which are fitted distance pieces of composition and a varying number of strips of thin sheet brass or tin called 'shims,' which, when removed, take up the lost motion due to the wear on the brasses. Later on I will describe to you the method of adjusting crosshead and connecting rod brasses, which constitutes one of the most important of the many duties which befall the marine engineer.

"The crankshaft is the member that actually turns the propeller, and hence is the connection between the producer and the consumer of the power, or the middleman, as they would tell you in business circles."

"He's the guy that causes the high cost of living; but I never heard him called a crank before," suggested O'Rourke.

"Anyhow, the crankshaft is a very important part of an engine," continued McAndrew. "Nearly all crankshafts are forged of mild open-hearth steel, but some still are built-up forgings of wrought iron. In some high-class marine work

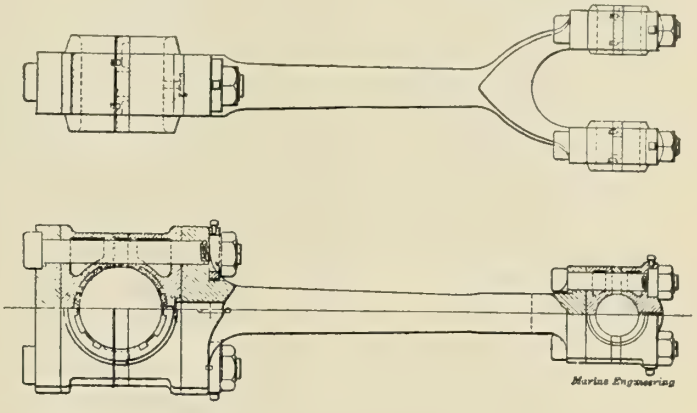


FIG. 7.—CONNECTING ROD

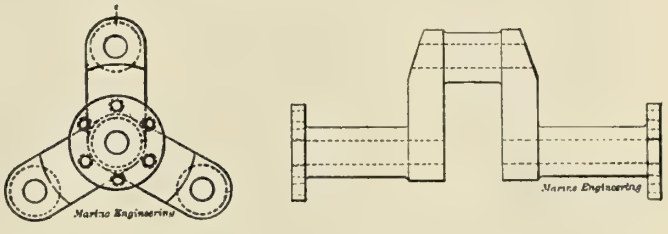


FIG. 8.—SECTION OF FORGED CRANKSHAFT

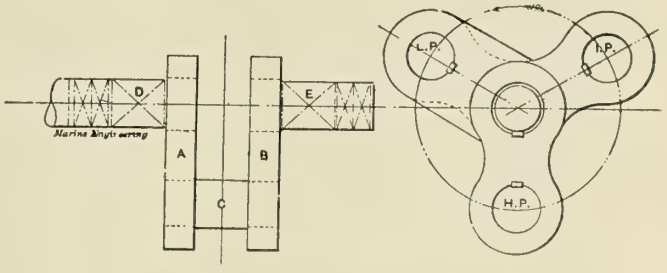


FIG. 9.—SECTION OF BUILT-UP CRANKSHAFT

the crank for each cylinder is forged in one solid piece, such as shown in Fig. 8.

"The advantage of a crankshaft of this kind is that the sections are interchangeable, so that, for instance, if the low-pressure crankpin should break the high-pressure crank could be put in its place and the engine run compound—that is, if the engine was of the triple-expansion type. The built-up crankshaft is, as its name indicates, composed of several parts, the slabs being shrunk and keyed onto the crank pins and sections of the shaft as shown in Fig. 9."

"Why do some crankshafts have holes in them?" inquired Pierce.

"That is done in high-class work for two principal reasons. One is that it saves weight and the other is that in making large forgings of this kind most of the imperfections, or 'pipes,' as they call them, are liable to be in the central part of the forging. Making the shaft hollow either removes the imperfections or exposes them to the view of the inspector.

"As I told you in the case of the piston rod, a hollow shaft is not stronger than a solid shaft, as many young men imagine; it is simply stronger than a solid shaft containing the same amount of metal. To transmit a twisting strain the metal on the outside of the shaft counts much more than metal at the center. For example, take a shaft 10 inches in diameter; the outer portion of the metal—only .16 inch in thickness—is of as much service in transmitting torsional or twisting strains as the metal 5 inches in diameter at the center of the shaft. Perhaps it will give you a better idea of what I am getting at to state that a shaft 16 inches in diameter, having a 10-inch hole through it, is equal in strength to a solid shaft 15 inches in diameter made of the same kind of metal.

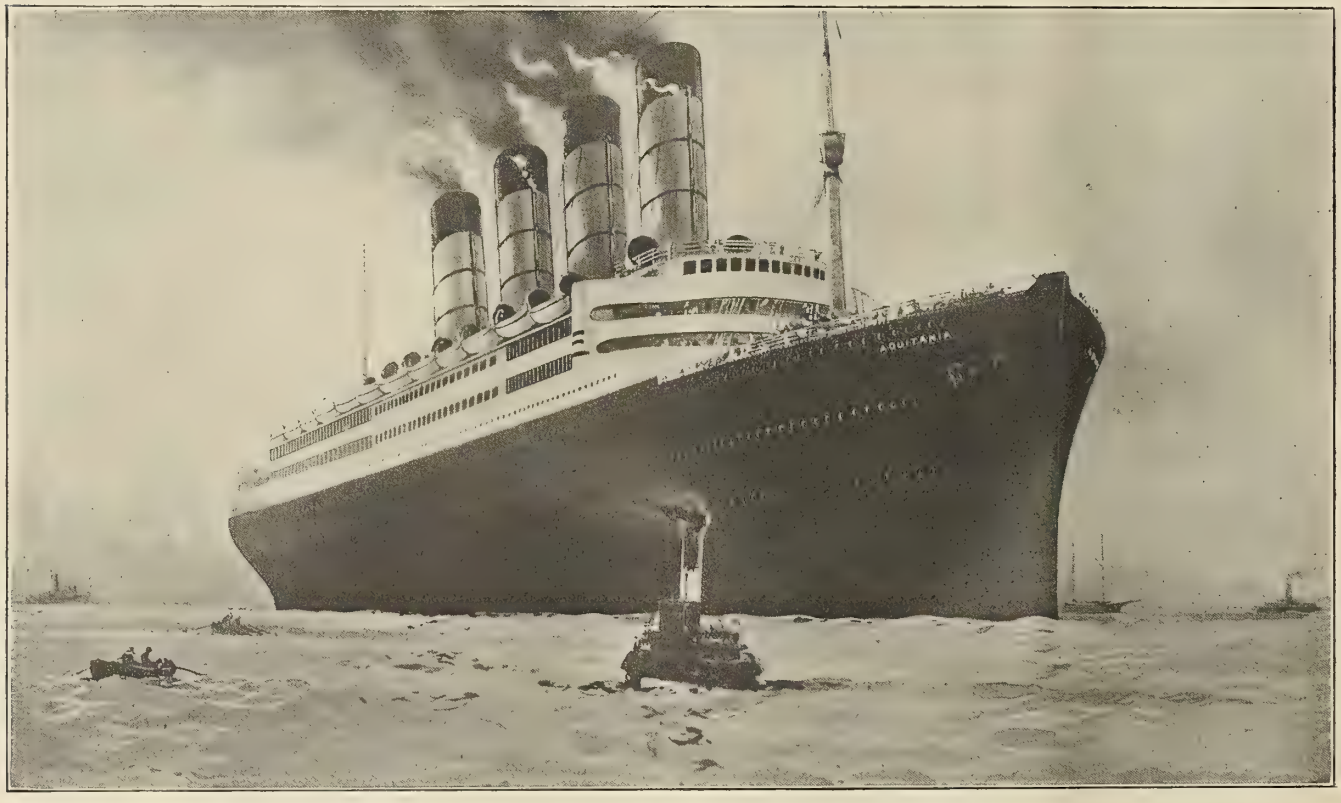
"Further advantages of hollow crank pins are that in case of a pin breaking it could be repaired temporarily by fitting a large bolt through the hole, which would allow the engine to be run slowly at least; the hole through crank pins is also used to advantage in some engines to permit of the fitting of centrifugal oiling devices.

(*To be continued.*)

LLOYDS' SHIPBUILDING REPORTS.—Lloyds' Shipbuilding Reports, which take into account only the vessels construction of which has actually begun, show that, excluding warships, there were under construction in the United Kingdom at the close of the quarter ended March 31, 1913, 563 vessels of 2,063,694 gross tons. The tonnage now under construction is nearly 94,000 tons more than was in hand at the end of last quarter, and exceeds by 377,000 tons the tonnage building in March a year ago.

Launch of the Aquitania

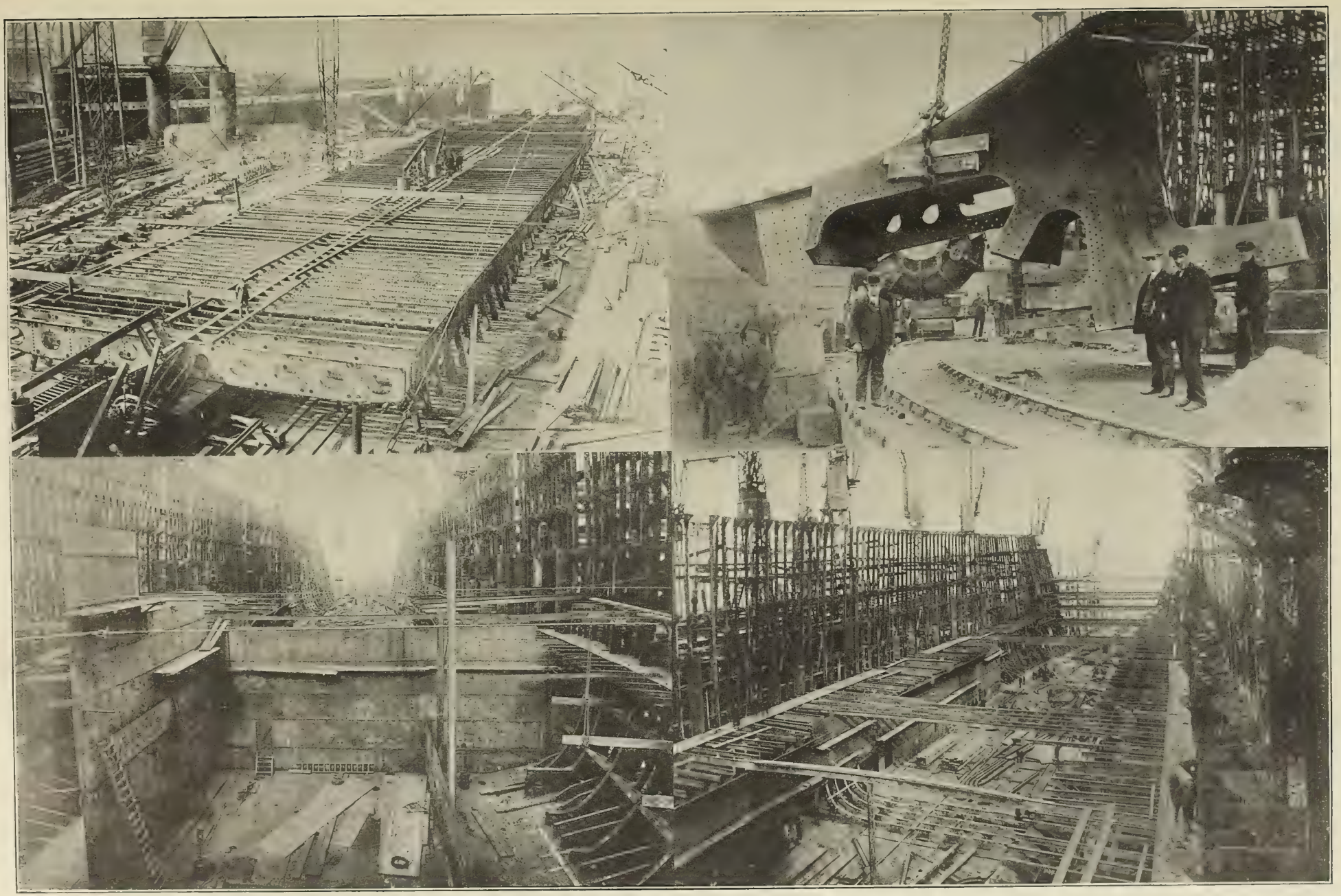
The new Cunard liner *Aquitania,* of 47,000 gross tons, was launched at the Clydebank yards of Messrs. John Brown & Co., Ltd., on April 21. According to information given out by the owners, but unconfirmed by the builders, the ship is 901 feet long, 97 feet beam, with a height from the keel to the boat deck of 92 feet 6 inches. The designed speed is 23 knots. Accommodations will be provided for 3,250 passengers, which with a crew of nearly 1,000, will bring the total number of persons on board to over 4,000. To insure safety, lifeboats capable of accommodating all persons on board are provided, and every effort has been made to make the ship practically unsinkable through the minute subdivision of the hull by both transverse and longitudinal bulkheads. There are 16 transverse bulkheads and throughout the machinery space watertight longitudinal bulkheads, spaced about 15 feet from the outer skin of the ship, are provided, the space thus inclosed being used for coal bunker purposes. According to information disclosed by the owners, the construction of the *Aquitania* conforms very closely to that of the *Lusitania* and *Mauretania,* although she is much larger. As can be seen from the photographs on the opposite page, showing the hull under various stages of construction, the ship is provided with Frahm anti-rolling tanks and watertight decks.



NEW CUNARD LINER AQUITANIA AS SHE WILL LOOK WHEN COMPLETED

The *Aquitania* was constructed on the same berth on which the *Lusitania* was built, but on account of her greater size the berth was enlarged, and for her launching the river was both deepened and widened. The fitting out basin where the ship is now being finished has also been dredged to accommodate the leviathan.

At the present time the Cunard Line has three other ships building, the *Andania* and *Alaunia,* sister ships of 13,000 tons each, which will be used in the Canadian service this summer. These ships accommodate only second and third class passengers. The third Cunarder under construction is the *Transylvania,* which will enter the company's Mediterranean service.



DOUBLE-BOTTOM FRAMING
LOOKING FORWARD FROM THE ENGINE ROOMS, SHOWING BULKHEAD CONSTRUCTION

PART OF STERN CASTING WEIGHING 62 TONS
VIEW ABOVE BOILER SPACE LOOKING FORWARD, SHOWING POSITION OF ANTI-ROLLING TANKS

HAMBURG-AMERICAN 50,000-TON LINER IMPERATOR READY FOR HER MAIDEN VOYAGE

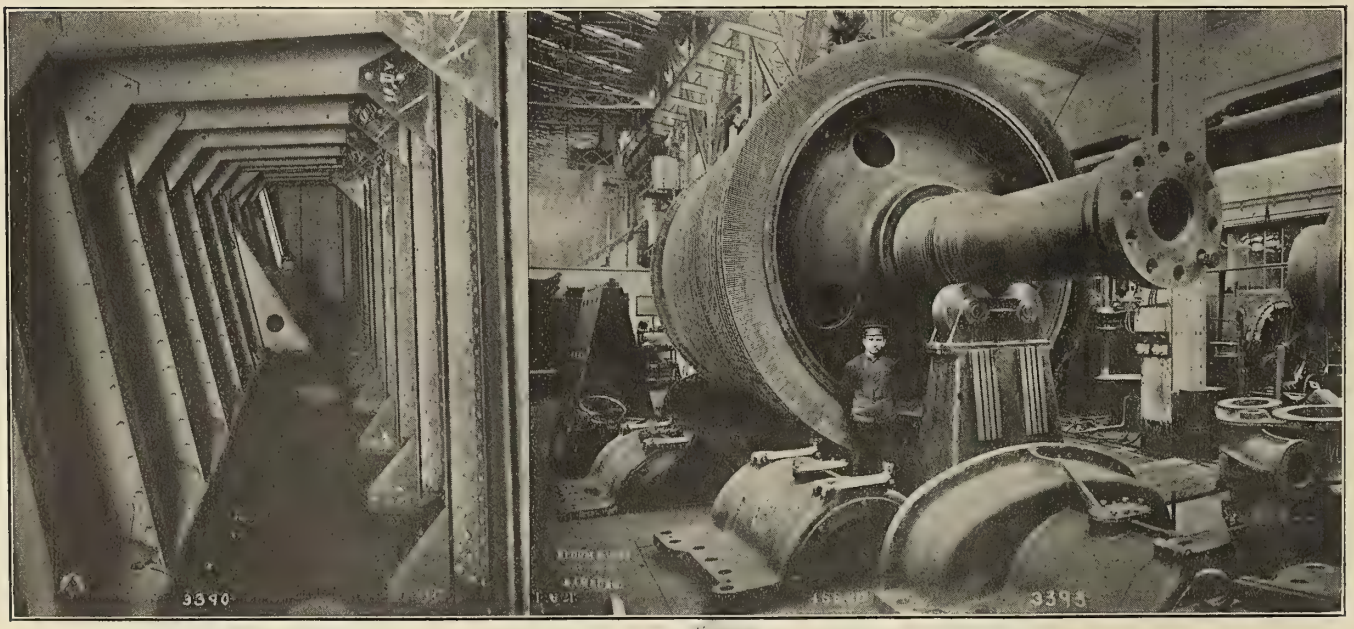
Hamburg-American Liner Imperator

Supplementing the description of the new Hamburg-American liner *Imperator,* which was published in our August, 1912, issue, we print in this issue several interior views of the new vessel, showing the elaborate arrangements for luxurious ocean traveling which have been incorporated in the design.

The construction of the *Imperator* was begun in the summer of 1910. She was launched in May, 1912, and will begin her regular service on the 24th of this month. The ship is 919 feet long over all, 879 feet long between perpendiculars, 98 feet beam, 62 feet depth to the uppermost continuous deck, and about 100 feet depth to the boat deck. With a displacement of 70,000 tons and a gross tonnage of 50,000, she is designed for a speed of 22½ knots, power being developed on four shafts by Parsons turbines designed to develop about 72,000 horsepower.

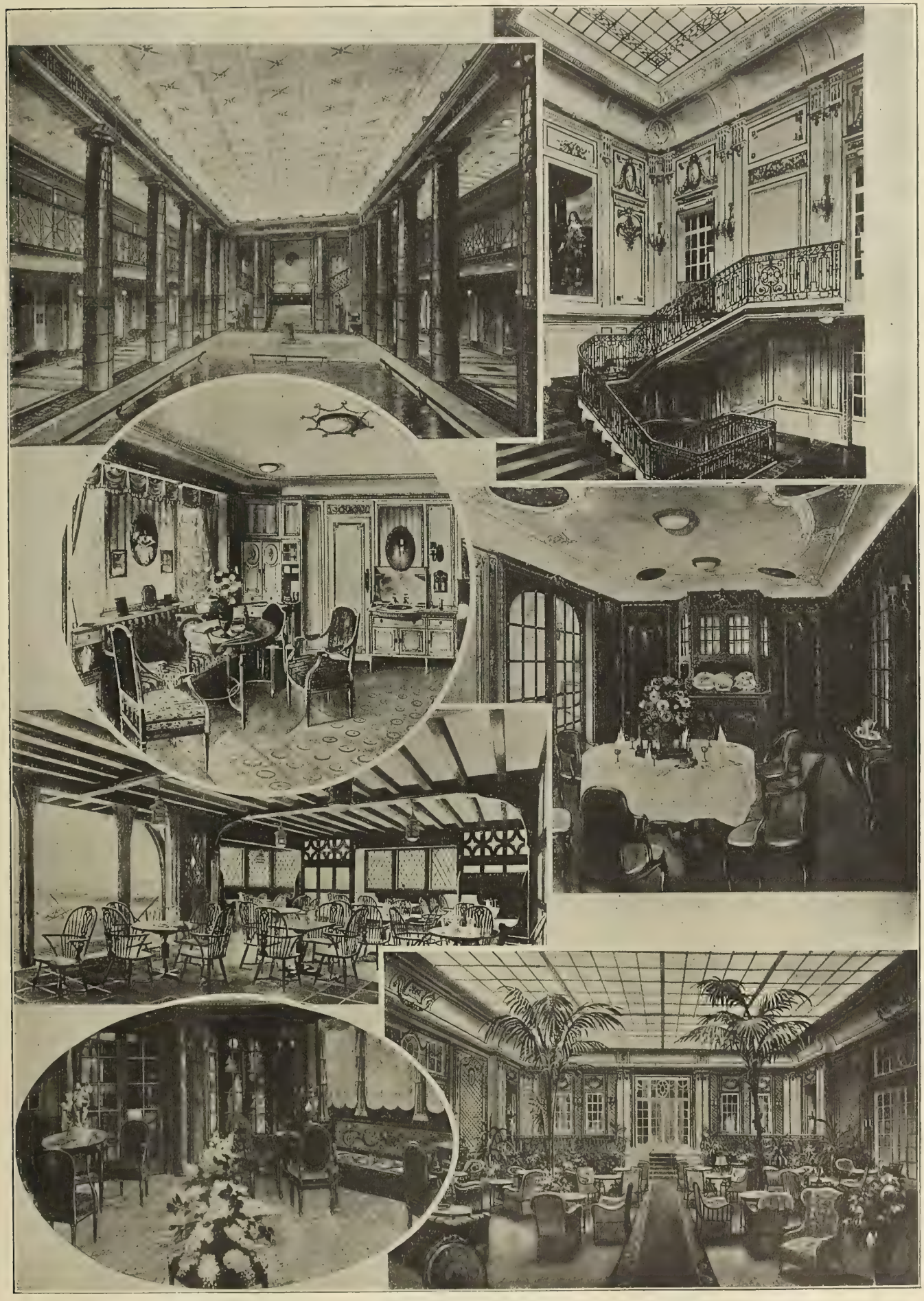
The hull is divided into 36 watertight compartments by means of 12 tranverse bulkheads, and also longitudinal bulkheads and watertight decks. Wing bunkers through the boiler space provide an inner skin, which, together with the double bottom and subdivision of the two engine rooms by longitudinal bulkheads, are designed to protect the ship effectually against disaster from collision, although lifeboats are provided to accommodate all persons on board the ship. Accommodations are provided for 700 first class, 600 second class, 940 third class and 1,750 fourth class passengers. The crew numbers over 1,000.

As can be seen from the illustrations the appointments of the ship involve many unique features. Besides the main dining rooms there are a Ritz-Carlton restaurant, a grill room, tea garden, veranda café, a palm garden, ball room and elaborate gymnasium and baths.



CONSTRUCTION OF INNER SKIN.

135-TON TURBINE ROTOR



SWIMMING POOL
BEDROOM OF PRIVATE SUITE
VERANDA CAFÉ
DRAWING ROOM OF PRIVATE SUITE

GRAND STAIRWAY
PRIVATE DINING ROOM
RITZ-CARLTON RESTAURANT AND WINTER GARDEN

Progress of the Oil Engine in Great Britain

To all appearances the Clyde is going to be the center of Diesel engine building in Britain. Some time ago Messrs. Burmeister & Wain, of Copenhagen, who so successfully engined *Selandia,* the first of the East Asiatic Company's motor liners, bought up the engine works in Glasgow of the London & Glasgow Shipbuilding & Engineering Company, from Messrs. Harland & Wolff, and set down a factory solely for the building of four-cycle Diesel engines, and now a new concern, viz., the North British Diesel Company, have come to the Clyde and are about to lay down a large factory for the building of two-cycle Diesels. There are, of course, some eight or nine firms on the Clyde who hold licenses for the building of Continental Diesels, and three of these firms are at present working on Diesel contracts, but the fact that before very long there will be two factories on the Clyde entirely devoted to the building of the high compression internal combustion engine is sufficient to show that the west of Scotland intends to retain its prominent position in the engineering world.

Of late we have read a lot about the number of Diesel engines building in Germany, Holland, Switzerland and other parts of the Continent, and after all not too much about what is going on in Britain. Accordingly, it will be of interest to many to know that there are building on the Clyde alone at the present moment no fewer than eighteen marine Diesel engines, all more or less of high power. Five of these engines are four-cycle Burmeister & Wain six-cylinder sets of 1,600 indicated horsepower each. Four are engines of 1,125 indicated horsepower each, while four others are six-cylinder 600 indicated horsepower sets intended as cruising machinery for two Japanese destroyers building by Messrs. Yarrow & Co., Ltd., Glasgow.

Messrs. Burmeister & Wain, it should be said, have equipped their Glasgow factory with machinery capable of turning out cylinders up to 40-inch bore. A cylinder of this diameter gives approximately 900 indicated horsepower, so that a six-cylinder engine could be built to give 5,400 indicated horsepower. Three such engines in a triple screw ship would mean a total horsepower of over 16,000, or well over that of the 550-foot to 600-foot 17-knot passenger liner. Whether we shall see Diesel engines in favor for powers above this or not time will tell, but these figures, I think, are sufficient to show that the Clyde is in a position to supply first-class liners with internal combustion machinery.

Early in March there was launched by Messrs Wm. Chalmers & Co., Rutherglen, the 400-ton deadweight carrying motor coaster *Innisshannon,* the eighth vessel of the type for the Coasting Motor Shipping Company, Glasgow. She is the second highest powered semi-Diesel ship in the world (the 350 brake horsepower Bolinders engined vessel *Isleford,* recently completed on the Clyde, being the highest), and much the highest powered British engined semi-Diesel vessel yet launched. She is 115 feet in length between perpendiculars, by 21 feet 6 inches beam by 10 feet 6 inches molded depth, and will carry her full cargo on a draft of 9 feet 6 inches. The engines take the form of a four-cylinder Beardmore solid injection hot bulb set of 220 brake-horsepower, the cylinders being 14 inches diameter by 14½-inch stroke, and the speed of the engine 280 revolutions per minute. The engine is direct reversible, reversing being carried out by compressed air on full load, and no clutch of any kind is fitted to the propeller shaft.

A special feature about this engine is that there is no water drip service fitted. Messrs. Wm. Beardmore & Co. have now given up fitting the water drip to these higher powered semi-Diesels, having so perfected the design that there is little or no gain in efficiency or saving in fuel by using water. Fuel to the extent of about 2,800 gallons will be carried in four tanks arranged in the engine room. On trials fully loaded a speed of 8 to 8½ knots is expected. I hope, however, in an early issue of INTERNATIONAL MARNE ENGINEERING, to publish drawings of this vessel's hull and machinery, with a description of this interesting Beardmore engine, which, by the way, has only just been put on the market.

The Coasting Motor Shipping Company, Glasgow, took delivery recently from Messrs. Peter MacGregor & Sons, Kirkintilloch, of a 150-ton deadweight carrying coaster named the *Inniseane.* The vessel is 67 feet in length by 18 feet 3 inches beam by 9 feet 6 inches molded depth, and has been built to pass through the locks on the Forth and Clyde Canal. Her load draft on open water is 8 feet 6 inches, but on the Canal this will be restricted to 8 feet 3 inches, and the carrying capacity to 135 tons. Her engines consist of a two-cylinder 90 brake horsepower Kromhout semi-Diesel set driving a four-bladed propeller through a reverse gear. About 1,200 gallons of fuel, or sufficient for three weeks' running, is carried in two tanks in the engine room.

Owing to the great demand for semi-Diesel engines for small commercial vessels, manufacturers of these motors are now putting higher powered sets on the market and giving some attention to improvements in design. Recently Messrs. Plenty & Sons, Newbury, the manufacturers of the British Kromhout motor put on the market through their selling agents, Messrs. Perman & Co., London, a new 130 brake horsepower two-cylinder set which promises to meet with favor for commercial boats. One or two rather noteworthy features have been embodied in the design of this engine, not the least of these being light vertical columns to the cylinder heads, which have the effect of taking the thrust off the bolts connecting the cylinder to the upper chamber. The arrangement is somewhat similar to that followed in the well-known Werkspoor four-cycle Diesel, which hails from Holland.

Again the Tuxham semi-Diesel, a Continental production and an engine now meeting with favor in Britain, is, I understand, to be turned out in sizes of 120 brake horsepower and upwards on the open crankpit model. There will be no scavenging valves, scavenging air being obtained by stepping the pistons after the lines of the M. A. N. and F. I. A. T. Diesels. The open crankpit is, of course, common in pure Diesel engines of the two-stroke cycle variety, but so far it has not been taken up seriously by builders of the low compression hot bulb engine. The advantage lies in great accessibility, it being possible at all times to watch the lubrication of the bottom ends.

It is intimated that we may also expect to see something new from the Bolinders Works in Stockholm. The Bolinders engine, as most of us know, reverses on the pre-ignition principal. Nothing as yet has been allowed to leak out regarding this, but it is quite probable that it will take the form of an air-reversing engine.

It will be of interest to many to know that the new motor coaster *Isleford,* formerly owned by Messrs. Mann, MacNeil & Co., Glasgow, and which ran trials in February, has been sold to the British Government.

HOT BULB.

LAUNCH OF THE SOCONY.—Constructed to meet the requirements in Panama Canal trade the oil tank ship *Socony.* the last of a fleet of four steamers built for the Standard Oil Company, New York, was launched this month at the yards of the New York Shipbuilding Company, Camden, N. J. The *Socony* is a bulk oil carrier of 30,000 barrels capacity, 330 feet long, 46 beam and 26 feet deep.

Letters from Practical Marine Engineers

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs

Below Decks on the Official Trial Trip of a Cruiser

The word had been passed around the yard in the morning by the foremen to the men selected as engine and fire-room crew for the trial trip of the new cruiser to report at the "shanty," the headquarters of the foreman of erection work, at 1.45 P. M.

Promptly at the time set about 200 men gathered there, speculating as to the positions that would be assigned them. A spectator could see at a glance that this was indeed a picked crew. Keen intelligence, indomitable courage, showed in every face. In a few minutes the foreman of erection work appeared with a paper in his hand, from which he read the names and the station assigned to each man. He and the shop foreman were to be chief engineers, the ship foremen or quartermen were to be assistant engineers, and licensed men in nearly every case were to serve as oilers, water tenders and blower engine men. Firemen had been gathered for weeks previous, every fireman who applied at the yard for a job being put to work as a helper, cleaning around and polishing bright work just to hold them, the work that they did previous to the trial trip not amounting to much in the way of profit to the company.

When the names had been read off the men were ordered to report aboard the ship at 7 A. M. on the morning of the trial trip, and then were sent back to their work. Every man felt proud of the fact that he was considered competent enough to be selected for this trip; besides, each man knew he would receive a bonus in addition to the overtime made on the trip.

At the appointed time all hands reported aboard the ship to the assistant engineer under whom he was detailed; this done, he looked up the sleeping berth to which he was assigned. The quarters were not very commodious, simply tiers of temporary bunks on the berth deck, in each of which was a straw mattress and pillow that had seen service several times before, and a horse blanket for covering. But who cared for that! The honor conferred was sufficient to make up for the hardships.

A separate detail of men, under the charge of the night engineer, had been aboard all night, and had steam on the eight double-end eight-furnace boilers. The first watch went below, and soon the three triple expansion engines were turning over. An assistant engineer and four oilers were detailed to each set of engines, with an additional oiler for the pumps in each engine room and one for each shaft alley; one assistant engineer was stationed in the fire rooms, with a water tender to every two boilers, one man to each blower engine, four firemen and two coal passers in each of the eight fire rooms, in each of the two watches, together with the machinists, electricians, blacksmiths, boilermakers, coppersmiths, and other mechanics, all of which constituted the "black squad."

At about 9 A. M. the lines were cast off and the long-looked-for trip began. The tension that everyone, from members of the firm down to coal passers, was under was apparent in the set expression of faces. This was in the days of premium for excess over the contract speed, each quarter knot that this ship exceeded the contract speed meaning $50,000 (£10,275) to the builders, and each man realized that he had some part in earning this.

At noontime the first meal was served. And what a feed! Uncle Sam paid the expenses of the official trips in those days, and expense did not cut much of a figure on that trip. Fish, flesh and fowl, with all the trimmings, desserts of all kinds, even fruit and ice cream, made up the bill of fare. No wonder the doctor's services were in such constant demand. Stomachs that had never before been called on to digest anything but ordinary food were now overloaded with lobster, shrimp, salads of all kinds, and other indigestible food, and a six-hour watch in the fire room was more than enough to bring on an attack of cramps. The wonder is that some one didn't die.

The word was passed to the oilers not to spare oil. They didn't. To an engineer accustomed to economizing as much as possible the apparent waste was appalling. Squirt cans were used only for oiling the pumps. In addition to the automatic oilers on every journal, hand oiling was done with a two-quart feeder that had a half-inch opening in the spout. Guides and piston rods were lubricated by the use of syringes. A hot journal meant expense to the builders; oil cost them nothing, being included in the cost of the trip. The oilers were supplied with a full suit of oilskins from the store room, and even with these on they were soon soaked to the skin. The vertical engines were necessarily very short-connected in order to get the cylinders below the protective deck, and this made it hard on the crosshead journals. A spray pipe, led up from the water service on each side of the crossheads, was kept playing on almost all of these journals, and the result can be imagined by any engineer. Every half hour or so the floor plates were washed down with a stream of water from a hose attached to the donkey pump, in order that the men could keep their footing.

After an uneventful run the ship anchored in the evening in Boston harbor, and the night watch took charge, giving the regular watches a chance to get a good night's rest.

Two days were spent in preparing for the run that was to be made over the official course off the coast of Maine. Journals that had not worked well on the run around to Boston were stripped, and where necessary smoothed up and readjusted. The crosshead journals in particular required attention; in some cases the brasses were found broken and were replaced with spare ones that were carried; almost all of the crosshead pins had cut some and had to be trued up by hand. Fires were hauled, furnaces and back connections cleaned out and scrubbed with wire brushes, and the tubes were swept. Every bolt and nut that could possibly work loose was gone over and tightened, and everything that could prevent a successful run was looked after in those two days.

The morning of the run dawned bright and fair, and the nervous strain was more apparent than ever in every man's face. The second watch was to take the ship out to the starting line, and then the first watch, who were the picked men of a picked crew, was to make the run, the second watch to bring the ship back to the anchorage.

About fifteen minutes before the starting line was reached the first watch came on. The speed had gradually been increased until the ship was then almost up to top speed. The second watch was ordered to stand by on deck for emergencies. A water tender was stationed at each stop valve on

deck, where the valve stems came through, so that in case of accident they could be promptly closed. As the ship crossed the line the whistle sounded a long blast and the race was on. A race? Yes, a race against time and for money, and no race between Mississippi River steamboats in the old days was ever more exciting.

Naval officers were taking indicator cards from every cylinder, including all auxiliaries, every fifteen minutes, together with other data, such as gage pressures, coal consumption, ashes, water level in boilers, air pressure in fire rooms, etc.

Rumors of all kinds, wholly unreliable, were passed fore and aft through the engine and fire rooms. Intense indeed was the excitement below decks. There was some excitement, of course, on deck, but the men below knew that they were the factors that made success or failure. All that was required of the deck crew was to steer a straight course, and this required no great skill or effort. In about two hours the whistle sounded again, indicating that the end of the course had been reached and the first half of the run completed. As the ship heeled when the wheel was put hard over to turn around for the last half of the run, there was a perceptible relaxation of nerves. One half of the run had been completed and everything was in good shape.

The run back over the course was a repetition of the first half, except that the excitement was, if possible, more intense. Would she keep it up? Everyone knew that if the speed attained during the first half could be maintained success was assured. The boilers had steamed well and the engines had stood up finely, and unless some blunder had been made in the designing the contract speed would surely be exceeded.

Again the whistle sounded as the finish line was crossed. The blowers were slowed, the main engines eased up, air-tight doors in the fire rooms were opened, and the second watch rushed below. The excitement over, the inevitable reaction came—the men who had made the run were in a pitiable condition, indeed almost everyone was in a state bordering on collapse. But they had the satisfaction of knowing that they had done their duty. They had done all that it was possible for men to do to make the run successful and profitable for their employers, and men could do no more.

The ship was run back to the anchorage under reduced speed. While on the way back the speed made on the official run was calculated and found to be a fraction over 23 knots, this being 2 knots over the contract, insuring a premium of $200,000 (£41,100) for the builders. The speed attained in knots was painted in large figures on both sides of one of the smokestacks, thus proudly proclaiming another success for the firm.

After a good night's rest the run home was begun the next morning. On the passage all manner of experiments were made to obtain data. Sometimes the two forward engines would be stopped, only the after one being used; then the two forward ones would be used, the after one being stopped. At different times two, four and six of the boilers would be cut out, the others being used under forced and natural draft, revolutions, speed of ship by log, coal consumption, and other data being taken for future calculations.

The run to the builder's yard was made without untoward event, and a tired but happy lot of men filed down the gangplank on arrival there. Everyone felt that never again would this ship make as good speed as had been made through their efforts. All were rewarded by the firm by the payment of a bonus to each of from $15 (£3.08) to $100 (£20.6), varying according to the responsibilities of the position they had filled.

J. S.

SALE OF THE FORE RIVER SHIPBUILDING COMPANY.—The Fore River Shipbuilding Company, Quincy, Mass., has been sold to the Bethlehem Steel Company, and hereafter will be operated as a department of the steel company.

English Ship Draftsmen and Technical Graduates

During the past year, while the writer was in England, he visited a number of shipyards, and part of the time was actually employed in the drawing office. In this way he was thrown among English draftsmen and technical graduates and had an opportunity to study their condition and compare them with men in like positions in the United States. As the average ship draftsman in America is rather dissatisfied and the technical graduate starting in believes he is rather badly treated, the condition under which these men work in England should be of interest.

To begin with, we must take the draftsman as he starts in and understand the conditions that surround him. The average English boy leaves school between fourteen and sixteen, unless he intends to go to college, and there are very few of them that do this, as well be seen later. Upon leaving school the boy is apprenticed to some trade until he becomes twenty-one. Thus a lad of fifteen, with a common grammar school education, starts in to become a draftsman. At first he acts as office boy, but later is advanced to assist in blue printing, and finally towards the end of his apprenticeship he is allowed to do a little drawing. As far as I could learn no effort is made to help him or teach him, but he is simply left to his own resources. At the end of his apprenticeship he generally leaves and takes up a position with some other firm where he can make a start, for, as a rule, after his apprenticeship is over his employers offer him little inducement.

Briefly, these are the conditions under which a draftsman begins. This apprenticeship exists to some extent in various forms in the United States, but in England it is universal. In seeking employment in a new firm the first question asked is, "Where did you serve your apprenticeship?" If the applicant has not served one there is no place open to him.

A draftsman's work is practically the same in England as in America, although I think a little more responsibility is thrown upon him, for, as will be known later, a greater portion of the calculation work falls upon him. The hours of work are practically the same in both countries, varying, of course, in different yards. Perhaps the Englishman has a little the advantage, for I believe the average is nearer seven and one-half hours than eight. Regarding vacations, he is much better off, for all the older men get two weeks in summer with pay and the young men one week. Then there are always from three days to a week at Christmas and sometimes at Easter, but there are very few scattered holidays such as there are in the United States. In other respects there is hardly any comparison.

The pay of the English draftsman is very small, the average man getting from $10 to $12 (£2 1s. 8d. to £2 10s.) a week. The maximum pay is $17 to $18 (£3 10s. 10d. to £3 15s.). On the Clyde the pay is smaller and $15 (£3 2s. 6d.) is generally the top limit. One man I met while with a noted English firm had been with the sompany eight years and was drawing $17 (£3 10s. 10d.) a week—the highest paid man in the office. This man, who was about thirty-five, was married and had two children. When work was slack in the office he was always in fear of losing his position, for it is the general policy to let the high paid men go and get cheaper and younger men when new work comes in. This case is typical of many others I might cite, for most of the men are married and struggling to maintain a home and bring up a family on from $12 to $18 (£2 10s. to £3 15s.) a week. To be sure, the price of living is less than in America, but the difference is much smaller than people believe. I have lived with these men in a shipyard town and know by experience that the living expenses are nearly the same. They live on their earnings because they must, but they have a much lower standard of living than American draftsmen.

To save money is absolutely impossible. One man getting

$17.50 (£3 12s. 11d.) a week told me he had saved only $10 (£2 1s. 8d.) in three years! To be sure, all this might be passed over if there was something better ahead, but there is not. When the draftsman's pay reaches $18 (£3 15s.) he has nothing whatever ahead of him. Of course some of them are advanced to chiefs, but very few, and even then, from what I have seen, the chief draftsman's position is little better.

The draftsman's hope is that some day he may find some new kind of work, perhaps in the Colonies. Many of them are looking to America, hoping some day to come here, where the draftsman has better opportunities and better pay. Some of them find openings in the various societies, such as Lloyds and the Board of Trade, but with a hundred applications for one position, as was the case this year, there is very little hope in that direction. An incident came to my notice that is worthy of mention. An advertisement appeared in one of the engineering papers wanting one ship draftsman in Australia. Over three hundred men on the Clyde alone answered this advertisement.

As regards ability and training from my observation, I believe that man for man they surpass the American draftsmen. The greater part of the men understand the various hull calculations, such as displacement, stability, strength, etc. Beyond the exact steps to follow in making the calculations, they of course know little, nor have they any conception of the finer problems of naval architecture, such as power and speed, distribution of displacement, etc. Very few American draftsmen, barring the technical graduates, are as familiar with calculations and none, I believe, would be found able to carry through stress calculations of a ship among waves. This condition is brought about by the English system of evening schools. Every shipyard town has its classes in naval architecture, and nearly all the apprentices attend these classes, some of them for seven or eight years. While this is a rather unsatisfactory education, yet, coupled with the daily practical work, it makes a good all-round man for the drawing office.

Perhaps the reader may ask why men go into drafting if such conditions exist? Simply because there is nothing else to do. England is overcrowded, and every man must fight, and fight hard, for his living. There are ten men looking for every place, and every place of any value is quickly filled by some friend or relative of the directors or management. Of course the men are dissatisfied, but there is nothing to do but submit. Shipbuilding presents as good an opening as anything, for it must be remembered that these same conditions exist in all lines of industry. In 1907, during the depression in shipbuilding, many of the draftsmen were forced to work in the yards as laborers.

The following incident shows exactly what these men are up against. In one office I came to work in the morning to find the thermometer at 38 degrees and all the men at work with overcoats and gloves. This condition existed day after day, and from the chief down they all were too afraid of losing their place if they complained to the management. Some offices treat their men much better; some give them a bonus at Christmas, but these are exceptions. None give any better pay, and always the raises are small, sometimes as low as 60 cents (2s. 6d.); a dollar (4s. 2d) is considered a good raise. Having thus seen briefly the condition of the ship draftsman, let us turn to the technical graduate, for his condition is much worse.

In a recent article in International Marine Engineering, Prof. Everett pointed out the handicap of the technical graduate in America. It is true that the technical graduate has a hard fight for a start in naval architecture in the United States, but much of this I believe is due to the poor condition of American shipbuilding. In England, however, he has absolutely no opening at all, either in naval architecture or any other engineering profession.

In American shipyards most of the technical and calculating work is done by the technical graduate. All the yards appreciate the value of the men in this capacity, and it gives the graduate an opening where he can make himself valuable to his employers and at the same time learn the practical end that is being carried on about him. Some of the graduates, however, enter the drawing office, of course at small pay, but they are given a chance and most of them make good. There are a few men also who start in by working in the yard for a short time, but there are very few who do this. The American technical graduate upon starting in generally gets from $15 to $20 (£3 2s. 6d. to £4 3s. 4d.) a week for office work, and this is a good living salary—at least, for a few years.

In England, however, his condition is totally different. A technical education there is practically four years thrown away or, as one graduate told me, worse than suicide. There is in England a class of men whose fathers are shipbuilders or men of influence in this line. These men are educated in Glasgow or some other technical college, and upon graduation step into good positions with a bright future before them. The average man, however, without influence or money, has a totally different outlook. He leaves college and is wanted by no one—in fact, with hardly an exception every shipyard will refuse him a position. With this state of affairs staring him in the face, he has two alternatives: either he must start in as an apprentice and serve two or three years under the same conditions as other apprentices, or buy his way into some firm as a pupil. There is a way of paying a considerable sum for an apprenticeship. Men that do this are called premium apprentices, and as far as I could learn the only difference between the regular and premium apprentices is that the latter pay a large sum and are given less attention.

The pupilage is really the better, if one can afford it, for the pupil is given opportunities to work in the various departments of the yard. He thus spends four or five years as a laborer in the yard, working the same hours as the other laborers. These pupils so called are taught nothing whatever, but left to their own resources, merely being transferred from one department to another. Several pupils and premium apprentices with whom I was acquainted while there knew less about actual shop work at the end of their terms than the graduates from the best American technical schools. Of course it all depends upon the man, but once the premium is paid the company does no more, and very few of the fellow workers give them any attention. At the end of the yard and shop term the pupil is transferred to the drawing room, only to find that he is not wanted and the chief is prejudiced against him.

One man I knew who was a Master of Science from one of the leading English engineering colleges was a premium apprentice in one of the leading shipyards, having paid a large sum or premium to the company. This man was seldom given any work to do, yet he wasn't allowed to leave the particular building in which he was placed. While I was with this company this man spent most of his time cleaning and repairing his bicycle!

As another illustration, there was another man with this company as a pupil who paid $1,000 (£206) for his pupilage. This man, who had been with the company four years, had passed through the various departments and was in the drawing office. He also was a Master of Science from one of the leading universities and was practically a draftsman, but his salary was only $2.50 (10s. 5d.) a week! Certainly a bright state of affairs after eight years of training.

These are only two of the many cases that I might mention, but they are typical of them all. Both of these were

smart, clever men, but had never been given a fighting chance. As I mentioned before the pupilage and premium apprenticeship are only open to those who can afford it, as the cost varies from $500 to $1,500 (£103 to £309). It surely isn't a bright outlook for a man who has spent four years at hard study to spend four more in the yard, only to graduate as a draftsman in the end. In four years of this kind of work one becomes very rusty in technical work and must lose all enthusiasm and all ambition for his profession.

In some yards the graduate is given a little better chance. Then, too, many work summers in the yards and become acquainted with the practical side during their college course, but in the end they are little better off. Taking it all through as far as it came to my notice, the technical graduate is much worse off than the non-technical draftsman and receives very little consideration from the shipyards. These conditions are not only to be found in shipbuilding but in all branches of engineering.

How can we account for this state of affairs? Simply that the English are a practical people, throwing all the emphasis on the art and none on the science of engineering. Much sooner would a yard promote one of their own trained apprentices to a responsible position than bring in a new man technically trained in naval architecture. One firm where I was employed had a chief draftsman in the merchant department who had never worked in any other yard, and everything was carried on as it had been for the last thirty years. In my opinion this policy, which is more or less universal in England, of failing to introduce new blood, is causing the ruin of some companies.

As I mentioned before, the draftsmen are well instructed in the evening schools, which are lacking in America, and are capable of doing a great deal of the calculation work. This may account somewhat for the treatment of the technical graduate. In the past these evening schools have turned out some very capable engineers, but can England keep up this same out-of-date policy in this age of science and competition? Engineering science has developed enormously in the last few years, and it is no longer possible to get training in these evening classes anywhere near equal to the technical colleges.

The condition of the draftsman, as I have shown, is caused by the overcrowded condition of England, but the status of the technical graduate is caused by employers themselves.

Thus, while Germany and America are creating a large corps of technically trained men and giving them every encouragement, England is training her men by the old evening school method and not even giving the technical graduate a chance to make good. Many of the English graduates in engineering are coming to America, where they are given a fair start, and of course many of them never return.

In the past England has held the lead in shipbuilding and still holds it far beyond any other nation, but can she keep up this policy and hold the lead? Truly it is a problem worthy of great thought, but one not to be treated here.

My aim has been merely to point out the deplorable condition in England of the young naval architect without influence and without money. It appears to be only a profession for men of wealth and influence and not open to everyone, as in America. L. B. Chapman.

Action of Rust

Water in the presence of iron decomposes, its oxygen combining with the iron forming oxide of iron, or rust. Its hydrogen is set free at the rate of about 44 cubic inches for each grain of rust developed. Rust occupies about twice the volume of the iron contained in it, and it absorbs from 18 to 28 percent by weight of moisture, so this moisture, if rust is not stopped, will attack other parts of the metal and form more rust. Rust once developed, if not cleaned off thoroughly before painting, will continue to develop under the paint. It will develop very fast under poor paint, but only slowly under good paint. Rust thus developed will gradually force the paint away from the metal and cause it to crack or peel off. The best way to overcome this action is to clean the metal as thoroughly as possible and then paint it with a good graphite paint. A Brother Engineer.

Motor Ship Monte Penedo

It appears that all sorts of rumors have been in circulation during the last few weeks regarding the motor ship *Monte Penedo,* mainly to the effect that the vessel has met with an accident and generally has not given satisfaction. As this is contrary to the truth, we take the opportunity to set forth herewith an account of the true state of affairs and of the results obtained up-to-date.

The vessel sailed from Hamburg on August 31, from Lisbon on Sept. 6, and arrived in Paranagua, Brazil, on Sept. 26 after a non-stop run, reporting "All in good order." From Paranagua the vessel sailed to Buenos Ayres, where the engines were overhauled and when cracks were found in several pistons. As a doubt existed regarding the advisability of allowing the vessel to proceed to the various loading ports in Platte and to return to Europe, we decided to take no unnecessary risks, and therefore replaced all pistons by others of improved design. Otherwise the engines were in excellent condition and the engineers reported that not one bearing ran warm throughout the whole voyage. The vessel sailed for the loading ports immediately the alteration was completed, and in due course left Rosario on the homeward voyage. On March 1 we received a telegram from Hamburg that the vessel had arrived, that the machinery was in excellent condition, and that during the thirty days' voyage the engines had worked splendidly and given every satisfaction. The average fuel consumption per twenty-four hours for all purposes amounted to 7,200 kilogrammes, or 151 grammes per indicated horsepower hour, the consumption of lubricating oil including auxiliaries, steering engine, etc., being 2.8 grammes per indicated horsepower hour. The engines were then subjected to a thorough inspection, and it was found that all internal surfaces, and especially the pistons, were clean and bright, showing that throughout the entire voyage the combustion had been perfect. All parts were carefully gaged without showing the slightest appreciable wear and tear.

It can therefore be readily seen that apart from the trouble we have had with the pistons, the replacing of which, as we have pointed out, was more a matter of precaution than absolute necessity, very satisfactory results have been obtained. We feel that when we say that, as absolutely no repairs were necessary, the Hamburg-Sud immediately billed the outward sailing for March 20, no further remarks on our part are necessary.

It is also of interest, however, that during heavy weather in the Bay the governors worked splendidly. In contrast to the racing steam engines and the attendant noise, it was only by observing the tachometer (which showed a maximum increase of from 10 to 12 revolutions per minute) that one knew the propellers were out of water. The pure air in all parts of the ship, and especially down below, was specially remarked upon by the crew. Gebrüder Sulzer.

Shipbuilding in the United States.—The Bureau of Navigation reports 1,114 sailing, steam and unrigged vessels of 260,265 gross tons built in the United States and officially numbered during the nine months ended March 31, 1913. During the corresponding nine months ended March 31, 1912, 1,051 sailing, steam and unrigged vessels of 151,241 gross tons were built in the United States and officially numbered.

Marine Articles in the Engineering Press

Steering Men-of-War by Electricity.—By Ensign W. A. Edwards, U. S. N. The U. S. S. *Chester* and the U. S. S. *Des Moines* are the only two ships of the United States navy which are equipped with the Cutler Hammer system of electric steering. The successful results obtained with this gear seem to indicate that other installations will soon appear in future ships, and the author gives with some detail his experiences in the operation of the gear, as a guide for those who may in some future time have occasion to use it. 4 illustrations. 5,500 words.—*United States Naval Institute Proceedings,* March.

The Passenger and Cargo Steamer Fauvette.—The *Fauvette* is a single-screw steamer owned by the General Steam Navigation Company, Ltd., London, and engaged in the London and Bordeaux service of that company. The vessel was built by Sir Raylton Dixon & Company, Ltd., of Middlesbrough, and is 315 feet long between perpendiculars, 43 feet 9 inches beam molded, 21 feet depth molded to upper deck. There are two continuous steel decks—the shelter and upper decks, respectively—extending over the length of the ship. Besides the double bottom, subdivision is further effected by five transverse watertight bulkheads. Accommodation is provided for 106 first class passengers, while a few second class passengers are provided for in an after-deck house. Electric power is used extensively for driving the deck machinery, which is very complete, and includes special cranes for the rapid handling of freight. The propelling machinery, built by the North Eastern Marine Engineering Company, Ltd., consists of a set of triple-expansion reciprocating engines of 3,300 indicated horsepower, for which steam is supplied by three large single-ended boilers. On trials a speed of 15.34 knots was obtained. 6 illustrations. 1,000 words.—*The Shipbuilder,* April.

The Weight Factor in Merchant Ship Design.—By T. C. Tobin, M. A. (Cantab.), M. I. N. A. There are three main ways in which the weight factor has to be considered in order to deal fully with the problem whose solution is the finished ship. The first of these involves the determination of the quantity and distribution chiefly in the vertical and longitudinal direction of the material forming the main structure so that it may have the necessary strength and rigidity to withstand all the stresses likely to be brought upon it. The second way in which the weight affects the design is in the vertical distribution of the total weight involved, determining, as it does, the vertical position of the center of gravity, one of the twin points affecting the stability of the ship The third way in which the weight factor makes itself felt is that, from a commercial point of view, the weights must be treated as mere weights to be handled under given conditions. It is to the consideration of this third phase of the weight factor as affecting the design of merchant vessels that this paper was prepared for presentation before the Liverpool Engineering Society, and the subject is exhaustively treated. 4,000 words. —*The Steamship,* April.

The Story of the Pacific Line.—The Pacific Steam Navigation Company was organized in 1840, and two paddle-wheel steamers, the *Chile* and *Peru,* 198 feet long, 50 feet beam, of 700 tons and 150 horsepower, were built and placed in service between Panama and Valparaiso. From this beginning the company's business continually grew. Affiliations were made with other steamship companies, mainly with the Royal Mail Steam Packet Company, which only recently formed a combination of the two companies, to be further strengthened by the addition of the Lamport & Holt Line. With the growth of the company the equipment has, of course, shown corresponding development. At the end of the eighties the company added to its fleet such vessels as the *Oruba* of 5,971 tons. In 1895 the twin-screw type of steamer was adopted, and has been adhered to, so that at the present time the company owns no fewer than eighteen twin-screw steamers. The largest steamer of the present fleet is the *Orcoma,* of 11,533 tons gross register, built in 1908 by Messrs. Beardmore. A large building programme is now on hand, the company having adopted the combination of high-pressure reciprocating engines driving two wing screws with a central propeller driven by a low-pressure turbine. Six vessels of this type are to be built, four of which will be of 15,000 tons each. The present total tonnage of ships building and built under the company's flag is put at 243,003 tons gross register. The article is an interesting account of the growth of this company, and is well illustrated by pictures of the earliest and latest of the company's vessels. 7 illustrations. 3,000 words.—*Marine Engineer and Naval Architect,* April.

Launch of the Andrea Doria.—The fifth Italian dreadnought, *Andrea Doria,* was launched at the Spezia Arsenal March 30. The new vessel, laid down March 24, 1912, is 554.5 feet long between perpendiculars, 91.86 feet extreme beam, 22,700 tons normal displacement, 28¾ feet normal draft. The propelling machinery consists of Parsons turbines aggregating 28,000 horsepower, divided into three groups in three separate compartments supplied with steam by twenty watertube Blechynden boilers, half of which are fitted for liquid fuel and half for "mixed combustion." The designed speed is 22½ knots. The main armament consists of thirteen 12-inch guns, arranged in five armored turrets, besides eighteen 3-inch guns and four torpedo tubes. The main armor belt is 10 inches thick, reduced to 8½ and 5½ inches at the ends. 4 illustrations. 850 words.—*The Engineer,* April 11.

The Emanuel Nobel.—The *Emanuel Nobel,* which is the second ship to be fitted with the new design of Werkspoor motors, was built by the Nederland Shipbuilding Company, of Amsterdam, for the Société Anonyme d'Armament, d'Industrie et de Commerce, of Antwerp. The ship is 390 feet 6 inches long by 51 feet molded beam and 21 feet molded depth. On 23 feet draft she displaces 9,560 tons, thus ranking as one of the largest motor ships afloat. On trial she attained a speed of 11.4 knots when loaded to her specified draft, which is nearly one-half a knot in excess of her contract speed. There are two sets of engines, with cylinders 22½ inches diameter by 40 inches stroke, which have a combined indicated horsepower of 2,850 at 180 revolutions per minute. All auxiliaries are steam driven. 3 illustrations. 980 words.—*The Engineer,* March 28.

New Coal Handling Plant at Fort William, Ontario.—The Canadian Pacific Railway recently put into operation at Fort William, Ontario, an extensive plant for handling coal from lake steamers, which is in several ways a radical departure from the usual method of handling by means of grab buckets. This plant is equipped with Hulett unloaders of the same general type as the unloading machines which are commonly used in handling ore at lake ports, and is the first installation of Hulett equipment for the purpose. The total length of the dock is approximately 3,000 feet, although the available water frontage or dock space is limited to about 600 feet, or the length of the largest coal ships. The two unloading machines, built by the Wellman-Seaver-Morgan Company, of Cleveland,

Ohio, are operated by electricity. 4 illustrations. 1,500 words. —*Railway and Engineering Review,* February 8.

The Weight of Marine Oil Engines.—The actual weights of marine oil engines, in spite of the many dissimilarities in design and the different types which are built, show no very marked variation for the same power. As a rough estimate, taking the usual slow-speed type of Diesel engine, it may be considered that the weight, including the accessories for the engine itself, is somewhere in the neighborhood of 200 pounds per brake-horsepower. Taken over a range of a large number of engines it has been found that the figures vary between 180 pounds and about 230 pounds per brake-horsepower, and are, of course, dependent largely upon the speed of revolution. The figures given are mainly for engines running between 110 and 140 or 150 revolutions per minute, and with the probable forthcoming adoption of speeds of 100 revolutions per minute and under, the weight would be slightly in excess of these figures. 1,800 words.—*The Motor Ship and Motor Boat,* February 20.

Shipbuilding Berth Gantries at the Nagasaki Yard.—Following a brief account of the history of the establishment of the various shipyards in Japan, attention is called to the first gantry to be erected in a private shipyard in Japan. This gantry, constructed from the designs of Sir William Arrol & Company, Ltd., of Glasgow, by the Mitsu-Bishi Company, Nagasaki, is designed for a double berth, although as yet only one berth has been erected. The length is 790 feet with a clear width between towers of 116 feet and a total height from the berth to the top of the structure of 186 feet at the water end. The main towers are spaced 92½ feet between centers longitudinally. The crane equipment in each berth consists of one 30-ton crane on the lower crane track, four 5-ton cranes and two 10-ton cranes on the upper crane track. The lower crane track is placed at a level of 114 feet above the floor of the berth at the water end, and the upper crane track is at a level of 138 feet. The 30-ton crane spans the full width of the berth, the smaller cranes span from the side to the center of the berth. Two illustrations. 1,350 words.—*Engineering,* February 14.

The Launch of the New York.—By Naval Constructor Robert Stocker, U. S. N., and Naval Constructor Henry Williams, U. S. N. Although it is generally recognized that a man-of-war is usually more difficult to launch than a merchant ship of equal or even greater displacement, because the weights are concentrated over a shorter length and because it is of greater beam, and even though the structure is more complicated, its local strength and ability to withstand the concentrated loads incident to launching are less than is the case with a merchant ship, nevertheless the various problems involved in the launching are not fully realized except by the naval constructors and the shipbuilders who have had similar work in hand. This article gives a very complete description of the launching of the *New York,* discussing in detail the various problems entering into the procedure. Such matters as the building slip, the launching ways, the method of release, the lubricant, the fore and after poppets and packing and internal shoring, are taken up in detail and well illustrated by drawings and photographs. Curves are given of the launching data and calculations of various forces and moments acting, and also showing data taken during the launching used in determining the coefficient of friction of the sliding surfaces from which a curve of coefficient of friction is deduced. 14 illustrations. 8,500 words.—*United States Naval Institute Proceedings,* December.

The Unsinkability of Modern Sea-going Ships.—By Geheimer Regierungstrat Professor Flamm, Charlottenburg. Two courses have hitherto been taken in order to find the limits for spacing bulkheads in merchant ships or to determine whether the arrangement of bulkheads adopted in a design is justifiable or not. One course is that of laying down hard-and-fast rules for the spacing of bulkheads admissible in passenger steamers. These rules have been framed on the model of those suggested by the British Bulkhead Committee of 1890, but they do not take into account the question of stability. The other course is that of establishing by individual calculation the floating power and the stability of the vessels when compartments of critical dimensions are assumed to be open to the sea. In the first case different percentages of deductions, evenly distributed over the whole space of the engine and boiler rooms, cargo holds and end compartments, are prescribed, whereas in the second instance these percentages are examined individually as to their amount and their situation within the damaged compartment. The author proceeds to discuss the question of which of these two methods of treatment is the most appropriate one, and to determine how far one may proceed in the first direction and at what point the second must be begun. As a result of his investigations he concludes that a careful determination of the stability in a damaged condition of large modern ships is required, and should be carried out for each particular vessel. He also points out, upon a consideration of the facts, that the watertight subdivisions of these ships, if it is based on the existing bulkhead curves, is worthless. Moreover, the bulkhead curve only regulates the spacing of transverse bulkheads; longitudinal bulkheads are not included. He holds that in any proposed regulations for the unsinkability of ships, that is, on the arrangement of bulkheads, this calculation should be compulsory. If not, the regulations are incomplete, and no public department can take upon itself the responsibility for the proper subdivisions of vessels not built according to rules improved in this direction. 12 illustrations. 2,700 words.—*Engineering,* February 14.

The Williams-Janney Variable Speed Gear.—Many attempts have been made to produce an efficient and compact infinitely variable hydraulic speed gear, but in nearly all cases difficulties are found in preventing leakage of the working fluid from the active system and providing for the taking up of wear in the working parts, and also in devising a method of control easy to operate and positive in its action. In the Williams-Janney gear leakage from the active system has been reduced to an amount only sufficient for lubricating the working parts; any wear that may take place is taken up automatically, but, owing to the film of oil maintained between the working parts theoretically there is no wear and the control, by means of which the speed is varied, can be easily operated by hand even in machines transmitting several hundred horsepower. The first Williams-Janney gear was brought out in 1907, but since then it has been effectually improved and is now being widely adopted by the United States and other navies for the control of the gun-training gear and a great variety of other uses in industrial applications where for any periods a variation in speed is required. The gear consists of two similar hydraulic units, each of which comprises a group of cylinders mounted on a shaft revolving in a fixed casing, one unit fulfilling the function of a pump and supplying fluid to the other, which acts as a motor. The pump is driven at a constant speed in one direction from the source of power, and means are provided whereby the stroke of its pistons may be varied, with a consequent result that the rate at which the fluid is delivered can be adjusted as desired from zero to the full capacity of the pump. The motor unit, however, has a fixed stroke, so that its speed will depend upon the quantity of fluid delivered by the pump. The change from one speed to another is effected without any steps whatsoever, while in passing from the forward to reverse direction on the motor the pump passes through the position of no-stroke, and thus the change is made without any shock. 14 illustrations. 2,000 words.—*Engineering,* Jan. 31.

New Books for the Marine Engineer's Library

Boiler Explosions in England

Boiler Explosions, Collapses and Mishaps. By E. J. Rimmer. Size, 5½ by 8½ inches. Pages, 135. New York, 1912: D. Van Nostrand Company, and London, 1912: Constable & Company, Ltd. Price, $1.75 net, and 4s. 6d. net.

Whenever boiler explosions are the subject of comment in the daily or technical press attention is invariably called to the fact that England, in spite of her immense industrial activities, is practically immune from disastrous boiler explosions. In fact, England is frequently held up as a model in this respect, although little is said about the laws and statutes that bring about this much-to-be desired state of affairs. It is doubtful if many boiler makers or engineers in the United States have a very clear idea of what these laws are, or how they are enforced. As a matter of fact England is by no means immune from boiler explosions, but each explosion that occurs, whether in a railway, marine or stationary boiler plant, is thoroughly investigated, and every possible means is utilized to establish beyond a doubt the actual cause of the explosion. The knowledge gained by such thorough investigations serves as both a warning and a guide for further construction, operation and inspection of steam boilers, and tends to raise the standard of safety to the highest level. All legislation in England in regard to boilers and boiler explosions is contained in the following statutes: Boiler Explosions Acts, 1882 and 1890; Factory and Workshop Acts, 1901; Railway Regulation Act, 1871; Metalliferous Mines Regulation Act, 1872; Coal Mines Act, 1911; Quarry Act, 1894; Merchant Shipping Act, 1894; Notice of Accidents Acts, 1894 and 1906; Railway Employment (prevention of accidents) Act, 1900. The most important statutes affecting all steam users are the first of the above named; that is, the Boiler Explosions Acts, 1882 and 1890. In this volume the author has endeavored to bring together the results of all the inquiries and investigations made under these two acts. There have been over 2,000 of these inquiries, and though each in turn has been the subject of comment by various authorities in the engineering press, it is very likely that the lessons which they teach have been forgotten or else have never been brought to the notice of the general body of steam users. Placing before the reader in this small volume the gist of all these inquiries, logically arranged and appropriately classified, so that the lessons which they teach as to the cause and prevention of boiler explosions may be thoroughly understood, is a task for which the author deserves great credit. The book is divided into four sections, as follows: Legislation in Regard to Boilers and Boiler Explosions; Formal Investigations and Findings of Commissioners as to Negligence; The Cause and Prevention of Explosions and Evidence of Causes and Explosions. The book has been ably prepared, and should prove of great value to boiler makers and boiler users.

Lessons in Mechanics for Marine Engineers and Engineering Students. By A. N. Somerscales. Size, 4½ by 7¼ inches. Pages, 276. Illustrations, 149. Glasgow, 1912: James Munro & Company, Ltd. Price, 3s. 6d. net.

The lessons given in this book were originally prepared for evening classes of students at the Hull Young People's Institute under the Technical Instruction Committee. In this institute most of the students are obliged to get an intelligent knowledge of the principles of mechanics without a previous training in algebraic and trigonometrical reasoning. For this reason the lessons are taught with a purely arithmetical treatment. The book is, therefore, essentially an elementary book. All of the subject matter and the examples and exercises given in connection with each chapter have been prepared with especial regard for the requirements of the marine engineer.

The Elements of Machine Design

REVIEWED BY PROF. C. H. PEABODY*

The Elements of Machine Design. Part II. Chiefly on engine details. By W. Cawthorne Unwin, F. R. S., LL. D., and A. L. Mellanby, D. Sc. Size, 5½ by 8½ inches. Pages, 426. Illustrations, 311. New York and London, 1912: Longmans, Green & Company. Price, $2.50 (7s. 6d.) net.

About thirty years ago there appeared in the series of Textbooks of Science a modest book on machine design by Professor Unwin, a man who was then and is now one of the leaders in technical education. By 1890 the book, in the eleventh edition, had grown to two volumes, and now appears this new and enlarged edition, the number of which is not stated.

From the first the work has been characterized by a judicious combination of sound theory and practical application. In the preface of this edition is the following advice to students: "It is in the nature of the case that, in school instruction and in textbooks for students, theoretical considerations occupy relatively a larger space than in ordinary routine of the drawing office. The experienced designer of machinery has no need to recur constantly to first principles, although no doubt he has systematized his experience by the aid of all the science he possesses. The inexperienced student, much as he will be assisted by theory in dealing with practical problems, will no doubt be liable to misapply it; for a knowledge of the limits within which theory can be trusted—or, more accurately, a knowledge of the extent to which a theory covers the data in any given case—is only arrived at gradually. Meanwhile he is likely to meet rebuffs which seem to imply that theory is held in very low esteem by practical engineers." Good doctrine this, and as applicable to American students as to English; but though the preface offers to the student an answer to rebuffs, it is not needed here, for if rebuffs are met the American may well digest them as he may if he has no answer of his own.

Some of the anxiety to be practical passes over from the preface into the body of the book, as in the treatment of rectangular plates on page 58, of combined indicator diagrams on page 81, and graphical representation of the dynamics of the piston and connecting rod on page 115; but this is largely a matter of discretion where the authors have as much right, if not more, than a reviewer.

In a book so full of good material it is a little difficult to select parts for special mention, but to the reviewer the following appealed most forcibly: The recommendation to use moderate steam pressure (180 pounds); the use of simultaneous equations for investigating diagrams of compound engines; the testing of spring-ring piston packing; the computation of stress due to slatting of connecting rods; the method of proportioning cranks, cross heads and connecting rods of stationary and locomotive engines, and the treatment of strength of fly-wheels.

The book is full of excellent drawings of parts and details of engine, etc.; but they are poorly executed. We should charge this to the publisher of an American book, because our engravers will give a good finish to any sketch; in any case this defect in such a book is much to be regretted.

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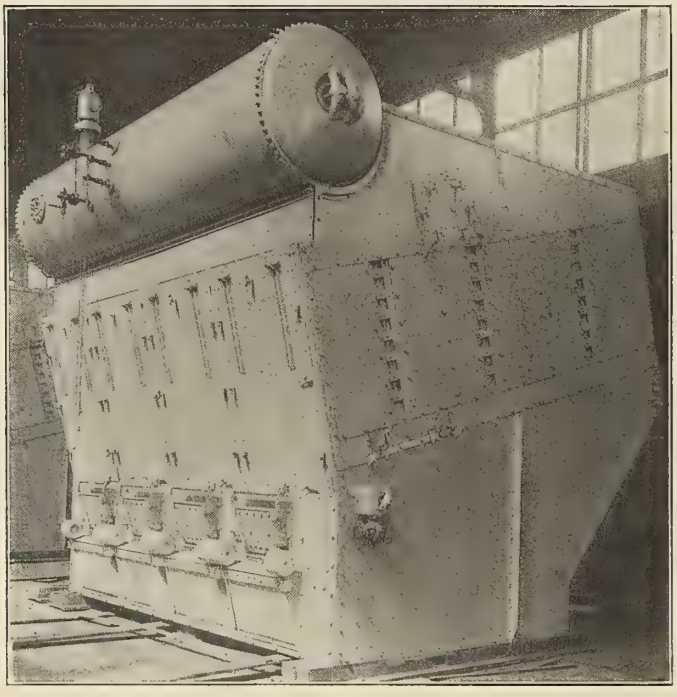
ENGINEERING SPECIALTIES

Babcock & Wilcox Dredge Type Boiler

The Babcock & Wilcox Company, New York, manufacture a standard dredge type boiler which has been applied successfully to many dredge installations, including large ocean-going dredges and floating dry docks. This boiler, since it is of the watertube type, and therefore combines the features of accessibility, safety, quick steaming and efficiency, was designed to take the place of the Scotch boiler, and is an actual marine boiler built in accordance with the requirements of the Supervising Inspectors of Steam Vessels. The boiler is built entirely of forged open hearth steel, no cast or malleable iron



being used under pressure. The tubes are all seamless steel tubes and like the Scotch boiler the boiler contains only straight tubes and expanded joints. This boiler, while considerably heavier and occupying more space than the well-known Babcock & Wilcox battleship type, still embodies the salient features of that widely used design. The large furnace volume secured by the upwardly sloping tubes covered by the reverberatory roof-baffle of firebrick and the special baffle arrangement directing the gases three times across the tubes, combine to give good efficiency and capacity even with indifferent firing. The dredge type of the Babcock & Wilcox boiler, illustrated herewith, was built for the United States army dredge *New Orleans,* now operating at the mouth of the Mississippi River.

"Imperial" Riveting Hammers Nos. 60 and 80

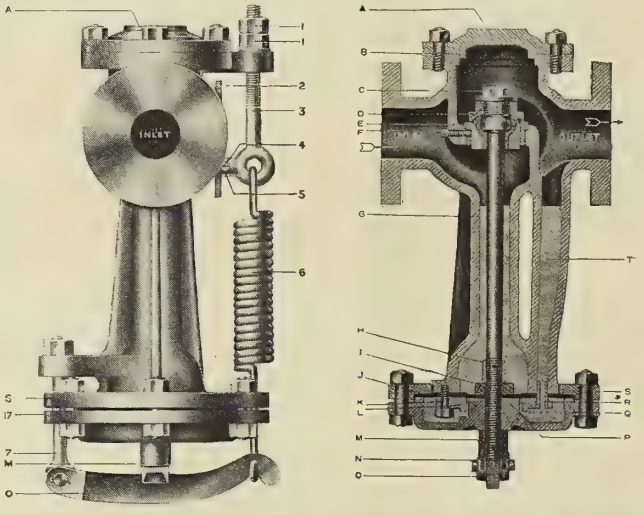
An improved pneumatic riveting hammer which has some novel features was brought out recently by the Ingersoll-Rand Company, New York. As will be seen from the illustration, the valve chamber is independent of the piston chamber, which permits the use of pistons of different lengths without the liability of valve breakages so common in pneumatic hammers where the piston travels through the valve or where the construction is such that the valve travels in line with the piston and is shifted by the piston compression. The grip handle is liberal in size, is improved with a single lever throttle with long bearing, and the handle is attached to the cylinder by means of two bolts which are parallel to the cylinder on the sides. This, it is claimed, insures perfect locking of the handle to the cylinder and precludes the necessity of a vise or other mechanical device for holding the tool in taking apart or assembling. This feature is especially convenient to the structural iron workers who are not always equipped with the proper facilities for repairing tools. The hammer can be taken apart on the floor or the bench, and the only appliance necessary is a wrench for removing the nuts on the bolts.

There is only one large port down the cylinder, equal in volume to the usual multiple port construction, but eliminating the liability of clogging, frequent in the older designs.

The hammer is short in length, light in weight and easy to handle; it has a very sensitive throttle control, making it specially suitable for drift pin work. The hammer is made in two sizes—No. 60, with a 6-inch stroke and capacity for driving rivets up to ⅞-inch in diameter, and No. 80, with an 8-inch stroke suitable for driving rivets up to 1¼ inches in diameter. The cylinder and handle are drop forged and all wearing parts are hardened. Another important feature is the sand blast finish on both the cylinder and handle, which overcomes the hand slippages so frequent with hammers of polished construction.

Auld "Quitetite" Reducing Valve

The Auld "Quitetite" reducing valve illustrated, which is manufactured in Scotland by David Auld & Sons Company, Ltd., of Glasgow, and in the United States by Schutte & Koerting Company, Philadelphia, Pa., is a useful boiler accessory for cases where it is desired to use reduced pressure steam. The valves are specially designed for accurately reducing from any high pressure down to any lower pressure

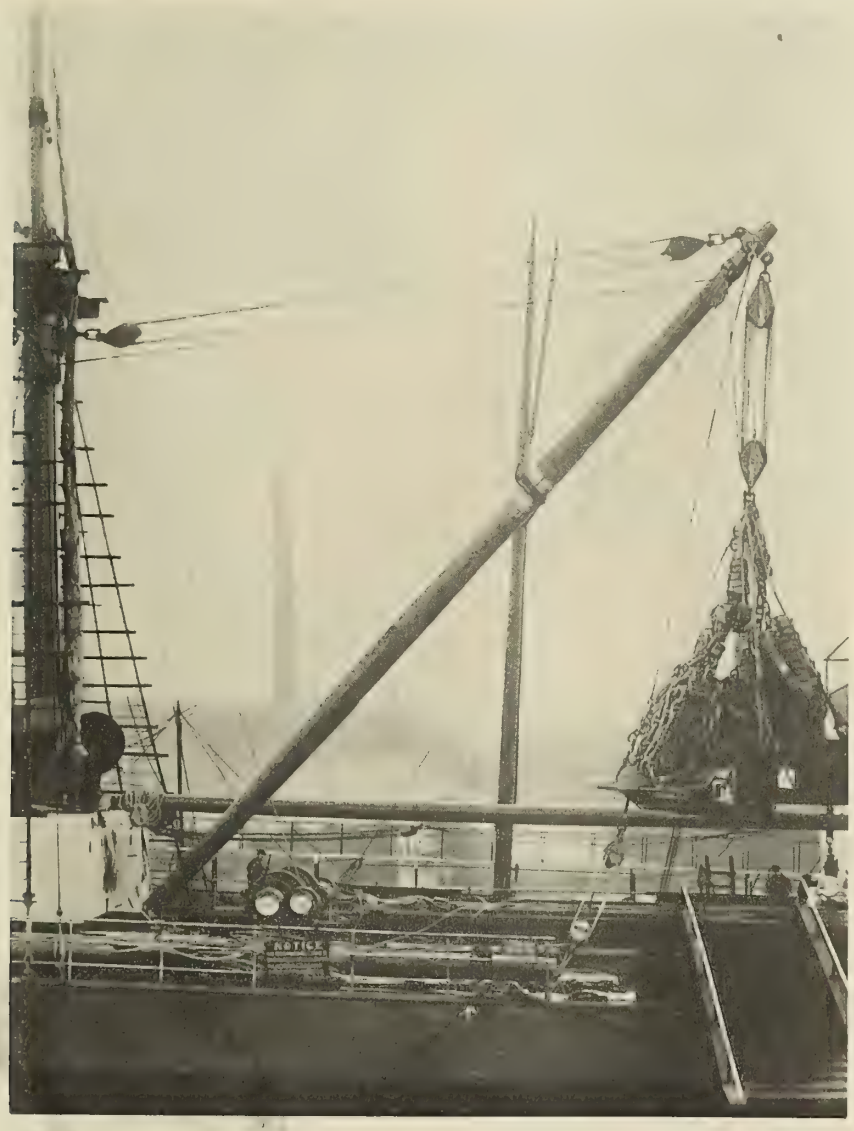


which may be desired, so that they will hold this reduced pressure constant irrespective of fluctuations on the initial or boiler side, and also when no steam is being used on the outlet side of the valve. With these valves it is claimed that it is quite possible to maintain a constant reduced pressure of two or three pounds on the outlet side, while the boiler pressure may be as high as 250 pounds per square inch. There are two branches, one on each side of the valve, one of which

is the inlet and the other the outlet. High-pressure steam enters through the inlet and acts between valve (*D*) at the top and piston (*P*) at the bottom, which are the same area, and, therefore, in equilibrium on the high-pressure side. Reduced pressure is obtained by screwing up adjusting nuts (1) on the spring bolt (3) until the pointer on the spring bolt is opposite the figure on the scale representing the reduced pressure required. Acting through the lever (o), at the bottom of the valve, the expansion of spring (6) opens up the valve between the inlet and outlet branches, and passes steam at a reduced pressure to the outlet side. When the pressure of this reduced steam tends to rise above that required it closes the valve by acting on the back of valve (*D*) and chamber (*Q*). When the pressure tends to fall, the tension of spring (6) overcomes the force holding the valve clased, and thereby opens the valve, allowing it to admit more steam to the low-pressure side, and in this way the reduced pressure is kept constant. A flexible diaphragm is fitted at the lower end of the valve body, which, it is claimed, makes a frictionless steam-tight packing between the stationary and movable lower parts of the valve. This diaphragm is protected from the action of steam by water of condensation which collects in the lower part of the valve and keeps the diaphragm cool. The valve is manufactured in all sizes, from one-half inch upward.

Steel Tubular Derrick

The illustration shows a 55-foot steel tubular derrick lifting a test load of 42½ tons at Messrs. Sir W. G. Armstrong Whitworth & Co.'s Elswick yard. The derrick was supplied by Messrs. The British Mannesmann Tube Company, Ltd., of Salisbury House, London, E. C. This firm manufactures all kinds of tubular masts, derricks, deck pillars, boat's davits, defense booms, etc., all of which up to 12 inches diameter are made of weldless steel tubing, and over this size of lapwelded tubing. The derricks are designed to carry any load up to and over 40 tons, and the davits up to and over 10 tons. Masts, derricks and defense booms are made in many lengths, and of course have many advantages over the solid articles, the most important being that they are much lighter for a given strength.



Burbridge Double Davits

R. Lickey & Company, Glasgow, has placed on the market a special type of boat davits so constructed that two boats can be carried in the same deck space as is now occupied by one, and, when ready for use, every part is securely inboard. The construction of the davits is simple, consisting of an ordinary ship's davit with a smaller one attached to it by means

of two heavy forged collars; thus ordinary davits can be altered without any structural alterations to the ship. The boats are stored one above the other. The upper boat is always suspended ready for immediate launching, but before

putting it outboard the small davits are swung around to the outboard position and a locking pin inserted. The movement of the upper boat when swung outboard will thus bring the small davits inboard over the lower boat, and the attachment

of this lower boat to the smaller davits is carried out while the upper boat is being lowered into the water. Immediately the upper boat is safely launched and the tackles free, the main davits are pulled inboard, so that the lower boat is carried safely outboard and then launched. Whenever possible the centers of the davits should coincide with the centers of the suspension points of the boats, otherwise the locking pinholes must be altered from their designed position.

Allen Dredger Buckets

The illustration shows a group of dredger buckets with cast steel backs which are equipped with Allen's imperial manganese steel lips and bushes. These buckets are manufactured by Edgar Allen & Co., Ltd., Imperial Steel Works, Tinsley,

Sheffield. As can be seen from the illustration, the bucket lips are renewable. Other parts of dredging apparatus, which are subject to heavy wear, are also made of Allen's imperial manganese steel, on account of its strength and lasting qualities.

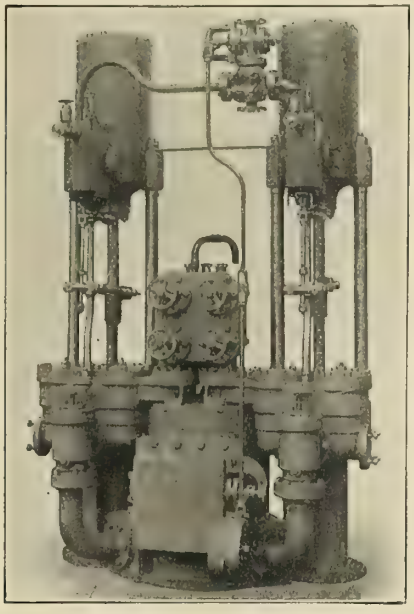
Motor Pumping Plant

The illustration shows a 12-horsepower motor pumping plant, manufactured by J. W. Brooke & Company, Ltd., Lowestoft, in which an 11-inch diameter centrifugal pump, capable of handling 1,300 gallons of water per minute against an 18-foot head, is mounted on a cast iron base, together with a Brooke

gasoline (petrol) engine of 12 horsepower. The engine operates at 1,000 revolutions per minute, and is connected to the pump by 2 to 1 spur machine-cut gearing, driving the pump at 500 revolutions per minute. This type of motor pumping plant is manufactured in sizes from 3 horsepower up to 50 horsepower, both portable and stationary, and is especially useful for emergency work where inaccessible places must be reached.

Hall Boiler Feed Pumps

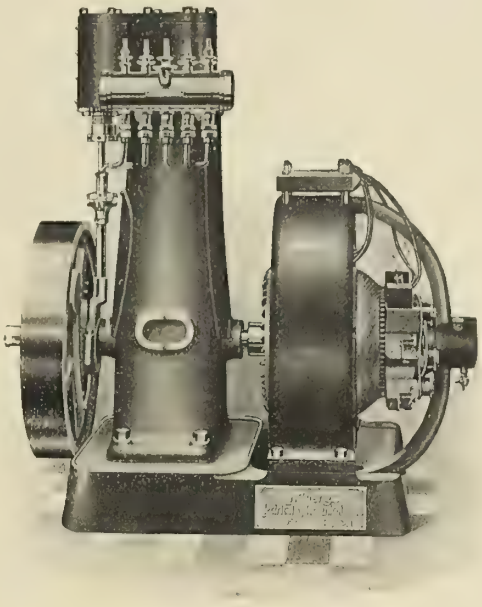
The illustration shows a pair of boiler feed pumps built by J. H. Hall & Sons, Ltd., Peterborough, for the Port of London Authorities for installation on their dredging vessels. Sixteen sets of these pumps were supplied for this purpose. Economy of operation is as important in dredge operations as in other work involving the use of large power plants. No small item in the economy of a steam plant is the performance of the boiler feed pumps, and in the Hall pumps special attention has been given in the design to reduce the consumption of steam to a minimum. This is accomplished by means of a cut-off in the steam cylinder capable of variation to the required du-



ties. The steam chest on these pumps is formed in two separate chambers, the larger containing the main valve, which is steam driven, and the smaller the auxiliary or impulse valve, which is mechanically driven by means of levers from the motion of the piston rod. The valve is open to steam at both ends, so that all the work put upon the gear is simply to lift the weight of this valve. The impulse valve has two functions: It admits steam at the end of each stroke to the main-valve chamber to drive this valve and, at the same time, it serves to cut off steam to the cylinder. This cut-off, together with the special system of cushioning of both steam valve and piston, makes the running of the Hall pump very smooth and steady.

Engberg's Direct-Connected Generating Sets

The Engberg's Electric & Mechanical Works, St. Joseph, Mich., have on the market direct-connected generating sets ranging from 2½ to 50 kilowatts capacity, which are particularly adapted for use on dredges. The sets comprise a vertical type engine and a multipolar generator compound-wound both mounted on the same base, and arranged for accessibility and ease of adjustment of all working parts. The valve of the engine is of the balanced piston type. A flywheel so designed as to retain the greater part of the weight up close to the main bearing of the engine frame is fitted. The governor, which is simple and effective, controlling the speed within 2 percent from low to full load, is of the manufacturer's own design. On all of these generating sets larger than 2½ kilowatts a special lubricating system is installed, made up of an oil pump situated in the base of the engine, pumping the oil from an oil reservoir up into a sight-feed oil cup, which leads to a distributing oil trough on the inside of the engine framing. From here oil pipes lead to all movable bearings, which are grooved to insure proper distribution of oil. The 2½ kilowatt set, which is illustrated, receives lubrication from a conveniently located sight-feed multiple oiler. The generators are of the multipolar type compound wound for 110 volts, unless other-



wise specified. The armature is of the iron-clad ventilated type, with laminated core, built of electrical sheet steel, thoroughly japanned before assembling, the drum and core provided with air ducts permitting a thorough circulation of air through the same. The engine crank coupling is coupled direct to the armature drum.

Personal

Charles S. Linch, marine engineer and naval architect, has opened an office at 33 Broadway, New York city.

Robert A. C. Smith, chairman of the New York State Harbor Commission, has been appointed Dock Commissioner of the Port of New York, succeeding Calvin Tomkins, whose resignation took effect April 2.

George Hills, formerly manager of the welding department of the C & C Electric Manufacturing Company, Garwood, N. J., is now associated with the Electric Welding Materials Company, New York City.

Obituary

Phillip H. Diehl, electrical engineer and inventor, and founder of the Diehl Manufacturing Company, Elizabeth, N. J., died at his home in Elizabeth, April 7.

Commander Walter J. Sears, U. S. N., who has been in charge of the Municipal Ferry Service of New York City since his retirement from the navy in 1907, died at the Naval Hospital, Brooklyn, March 29, in his fifty-sixth year.

Edmund Haynes Haswell, well known as a steamship man, and at one time head of the Pacific Mail Steamship Company, died in New Rochelle, April 3, at the age of eighty.

William H. Fletcher, vice-president of the W. & A. Fletcher Company, Hoboken, N. J., died at his home in New York City on April 2 at the age of fifty-six. Mr. Fletcher was one of the best-known marine engineers and shipbuilders in the United States.

George William Quintard, president of the Quintard Iron Works, New York, died April 2 in New York City at the age of ninety. Throughout his life Mr. Quintard was prominently identified with engine building, shipbuilding and steamship interests in the United States.

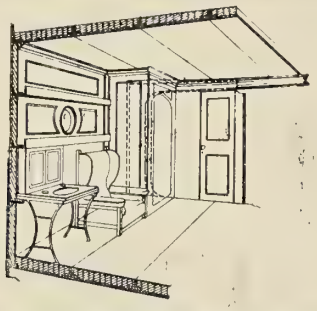
SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

1,052,060. CONSTRUCTION OF STATEROOMS. JOSEPH W. ISHERWOOD, OF MIDDLESBROUGH, ENGLAND.

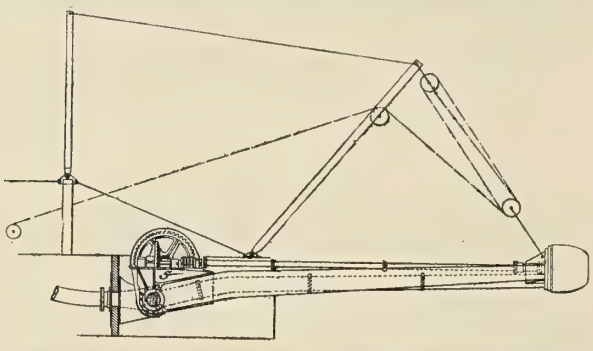
Claim 1.—In a ship provided with transverse frames and beams; side and deck plating secured directly to said frames and beams respectively; a partition coinciding with one of said transverse frames and beams; and



a longitudinal beam located above the free space inclosed by said partition, and located above said deck plating thereby leaving the said inclosed free space unobstructed by said longitudinal beam. Three claims.

1,052,148. HYDRAULIC DREDGE. THOMAS JARDINE, OF PATERSON, N. J.

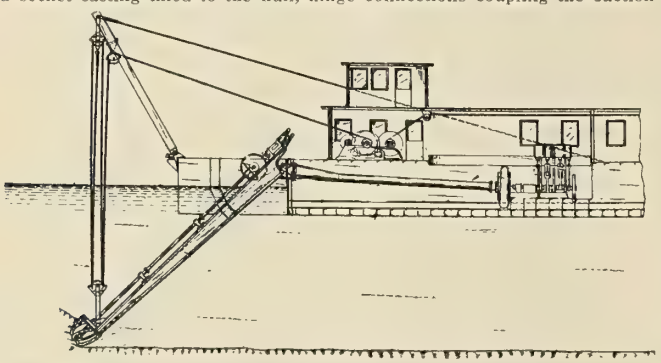
Claim 5.—A trunnion head for hydraulic dredges, comprising, in a unitary structure, a bed plate to receive separated shaft bearings, downwardly depending oil reservoirs made integral with said bearings for



the reception of gearing, vertical plate surfaces for connection to a supporting frame or ladder, and lateral journals or trunnions adapted to be mounted in bearings on the hull of a hydraulic dredge. Six claims.

1,052,176. HYDRAULIC DREDGE. ARTHUR W. ROBINSON, OF MONTREAL, QUEBEC, CANADA.

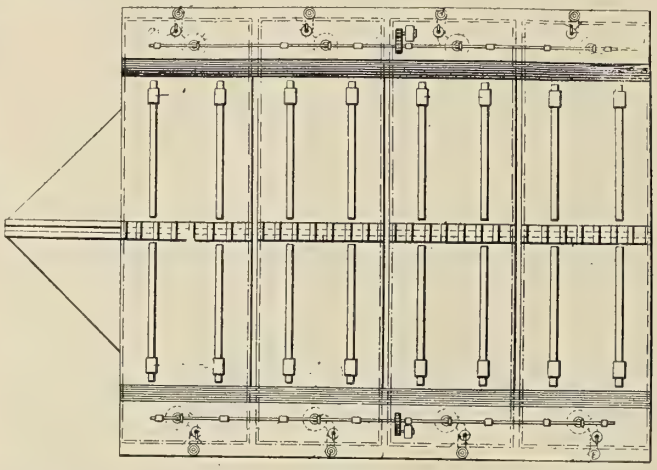
Claim 3.—In a hydraulic dredge, the combination, with a dredge hull, of a suction frame comprising two connected longitudinal plate girders, a socket casting fixed to the hull, hinge connections coupling the suction



frame to said socket casting, an outer suction pipe section supported on the suction frame, a ball casting secured to said outer suction pipe section and fitting the socket casting in line axially with the hinge connections, and an inner suction pipe section secured to the socket casting. Four claims.

1,052,225. FLOATING DRY-DOCK. WILLIAM THOMAS DONNELLY, OF BROOKLYN, N. Y.

Abstract.—The invention has for its object to provide valves, intermediate the combined inlets and outlets of the compartments of the dock and the centrifugal pumps therein, which are automatically and manually operatable to interrupt communication between the combined inlets and outlets of the compartments and the pumps therein and simultaneously establish direct communication between the combined inlets and outlets and the compartments, so as to admit water directly into the compartments of the dock; that is, without passing through the pumps, and which are automatically and manually operatable to establish communication between the combined inlets and outlets of the compartments



and the pumps therein and simultaneously interrupt communication between the combined inlets and outlets and the compartments, so as to cause the water to be exhausted from the compartments, by the pumps when they are started. Twelve claims.

1,053,047. BOAT HOISTING AND LOWERING APPARATUS. ANTHONY JOSEPH LEWKOWICZ, OF NEW YORK, N. Y., ASSIGNOR TO THE MARTIN MARINE LIFE SAVING DEVICES, LTD., OF TORONTO, ONT., CANADA, A CORPORATION OF ONTARIO, CANADA.

Claim 1.—In a boat hoisting and lowering apparatus, the combination of the davit falls, a drum on which said falls may be wound, a brake associated therewith, controlling the unwinding revolution of said drum, and means to rotate said drum arranged to be moved into and out of operative relation with it, said rotating means being prevented from moving to its inoperative position until said drum is under the control of said brake. Twenty-one claims.

1,049,490. CONVERTIBLE TANK VESSEL. CHARLES P. M. JACK, OF NEW YORK, N. Y.

Claim 1.—In a convertible freighter and tank vessel, a ship's hold, a number of removable cylindrical tanks vertically placed therein; and adjustable means connecting said tanks together and to the sides of the hold. Four claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn Place, W. C., London.

5,649. IMPROVEMENTS IN AND RELATING TO SHIPS' CABINS. HOSKINS & SON, LTD., OF NEPTUNE WORKS, TRINITY STREET, BIRMINGHAM, AND W. GRAY, OF 65 FENCHURCH STREET, LONDON.

This invention relates to furniture for ships' cabins, and has for its principal object the provision of good wardrobe accommodation without encroachment on the space required for berths, sofas, etc. The bulkhead between two adjacent cabins has a central gap or space adapted to admit the fitting of which provides the combined lavatory and wardrobe accommodation for the cabins on the respective sides of the bulkhead. In each cabin the larger compartment provides wardrobe accommodation, with drawers beneath the hanging space if desired, while the smaller compartment provides for the reception of the wash basin and other utensils. The uper part of the lavatory compartment may be constructed to provide a cupboard and lockers.

5,737. IMPROVEMENTS CONNECTED WITH SHIPS' STEERING GEARS. J. R. CLAY, OF WORCESTER ROAD, BOOTLE, LANCASHIRE.

This invention relates to mechanism designed to prevent orders being wrongly carried out in connection with the steering of ships, which is performed by an engine controlled from a wheel on a shaft through gearing. For this purpose a pair of oppositely toothed ratched wheels are fixed and a pair of diametrically opposite detents are arranged alternatively to engage the wheels so as to allow the wheel to be turned in only one or the other direction according to which detent engages the wheels. The detents are operated by the person giving the orders.

24,151. APPARATUS FOR FLOODING THE COMPARTMENTS OF SHIPS. J. L. BRUNTON AND W. B. BRUNTON, WESTCOMBE PARK, KENT.

This invention relates to the flooding of the compartments of ships. On each side of the ship is arranged a main connected to the various compartments by valves and also connected by a valve to the discharge pipe from the condensers so that the whole or part of the discharge can be led to any compartment. The valves are operated by hydraulic cylinders and the supply of high-pressure water to these cylinders is controlled from the bridge or other distant point by apparatus similar to that now employed for opening and closing bulkhead doors. The mains may be supplied by a pump.